APT1000 Modbus Register Map Firmware Version 7

Issue: A **3rd January 2020**

General Note: Parameters with variable numeric values are entered and stored as integer values. The actual value that this integer represents will depend upon the number of decimal places it is scaled to. Register 28 is set during manufacture and defines the number of decimal places set. If set to 1 the Integer value is divided by 10, if set to 2 by 100 and if set to 3 by 1000. For example an integer value of 123456 with register 28 set to 2 would mean an actual value of 1234.56 Refer to the Functionality Column for a description of the meaining of each register.

Factory / User. Factory registers are read only, either as results of the calculation chain, or a fixed factory setting which is for information only. User registers may be edited.

Parameter Description	Register Type	Register Address	Coils/Registers	Default Value	Max Value	Min Value	Functionality of parameter	Short Description	Factory / User Parameter	User Access	Comments
Modbus Slave Address	Word	0	APT1000 Modbus address	1	247	1	Unique modbus address of this APT1000. To change refer to Register 1 description	Unique Modbus ident of the APT1000	User	Read / Write Access	
Enable Modbus Address edit	Bit	1 - Bit 1	Modbus address change enable bit	0	1	0	This value is set to 0 unless Modbus ident is required to be changed Steps to set the new Modbus slave Address 1) Set this bit to value = 1 and write to APT1000 2) Modify the Modbus slave address (Register 0)with the required Modbus address and write to APT1000 3) Set this bit to value = 0 and write to APT1000 After this final step the device will now only respond to commands addressed to the ident set in Register 0.	Bit setting to allow change to Modbus ident	User	Read / Write Access	
Temperature Compensation Enable	Bit	1 - Bit 2	Temperature Compensation Enable Bit	1	1	0	The value of the bit enables or disables temperature compensation. If the bit is set to 1 temperature compensation for presure values is enabled, else if set to 0 the temperature compensation is disabled.	Enble or disable temperature compensation	User	Read / Write Access	
Secondary Measured Value (temperature)	Word	2	Secondary measured value	-	-	-	Temperature in 0.1 °C resolution. Held as an integer value e.g. 25.1 °C is represented as 251.	Measured temeperature value	Factory	Read Only	
Actual Measured Value (Pressure)	Word	4	Actual pressure on sensor hi	The pressure values can range from -2,147,483,648 to 2,147,483,647.			Actual pressure in mm H2O currently being measured by the APT1000. This value is held as an integer, but it's actual meaning is defined according to the decimal place setting in register 28	Actual pressure on APT1000 in mm H20	Factory	Read Only	
	Word	5	Actual pressure on sensor lo								
Parameters used for Level Calculation	Word	6	Specific gravity	1000	3000	500	Value of the Specific Gravity of the fluid being measured. Value is entered as actual SG x 1000. e.g. for an SG of 1.025 enter 1025	Specific Gravity Value	User	Read / Write Access	
	Word	7	Liquid level above sensor hi	-	-	-	Actual liquid level in mm H2O above sensor location currently being measured by the sensor. Calculated as Actual MV (registers 4 & 5) corrected for Specific Gravity (register 6). Value given is an integer, but it's actual meaning is defined according to the decimal place setting in register 28	Liquid level above sensor	Factory	Read Only	
	Word	8	Liquid level above sensor lo								
	Word	9	Sensor position offset hi	0	100000	-100000	Zero position offset. i.e. the dimension the sensor is mounted above or below the tank bottom. If the sensor is located below the tank bottom value is entered as a negative number. Enter in millimetres as an integer value. **This register is not affected by setting of register 28.**	Sensor offset in mm	User	Read / Write Access	
	Word	10	Sensor position offset lo								

	Word	12	Total tank height	10000	50000	1	Enter total tank height in millimetres as an integer value. Total height is defined as from tank base (empty point) to tank top (100% full point). **This register is not affected by setting of register 28.**	Total tank height in mm	User	Read / Write Access	
	Word	13	Percentage tank level hi	-	-	0	Display of current tank percent level. Value derived based comparing actual level in tank (registers 23 & 24) with total tank depth (register 12). Values are given to 2 decimal places presented as an integer, e.g. a value of 5 = 0.05%.	% tank level	User	Read Only	
	Word	14	Percentage tank level lo								
Volume Calculation	Word	15	Tank capacity hi	100000	16777215	0	Enter total tank volume at the same 100% full point used for tank height (register 12). Enter as an integer value in units of measure to be displayed in, with consideration of the number of decimal points set in register 17. For example tank volume 95.682 cubic metres then enter value of 95682 and register 17 would have a value of 3.	Total Tank Volume in required Engineering units	User	Read / Write Access	Only implemented in Version 6.7 firmware and above
	Word	16	Tank capacity lo								
	Word	17	Decimal points - Volume	1	3	0	This register defines the number of decimal points that are to be applied to the integer value held in registers 15 & 16 - Tank Capacity, and registers 18 & 19 - Actual Volume.	Number of decimal points to be applied	User	Read / Write Access	
	Word	18	Actual volume hi	-	-	0	Display of actual content in the tank in the units of measure in use. Calculated by multiplying tank capacily (registers 15 & 16) by current percentage volume (registers 20 & 21). The value is provided as an integer and is scaled according to the setting of register 17	Current Tank Volume in required Engineering units	Factory	Read Only	
	Word	19	Actual volume lo								
	Word	20	Percentage tank volume hi	-	-	0	Display of current tank percent full. Calculated by taking the value for tank percent full (registers 13 & 14) and comparing this to the corresponding value in the tank look up table (registers 144 to 243). Value is given to 2 decimal places presented as an integer, e.g. a value of 5 = 0.05%.	% full in volume terms	Factory	Read Only	
	Word	21	Percentage tank volume lo								
RS 485 Delay	Word	22	RS 485 delay time	20	5000	0	This parameter is used to introduce a delay time before the APT1000 responds to a data request from a Master. It may be required for example where Master devices require time to switch from Tx to Rx. The value is entered in milliseconds up to 5000 (5 seconds). The setting is retained if the unit is power cycled. The default value is 20ms.	APT1000 response delay time	User	Read / Write Access	
Level Calculation (Con't)	Word	23	Actual Level hi	-	0	700000	Actual level of liquid in the tank in mm H2O calculated by adding the sensor offset (registers 9 & 10) to the liquid level above sensor (registers 7 & 8). Value is held as an integer, but actual meaning is defined according to the decimal place setting in register 28	% full in level terms	Factory	Read Only	
	Word	24	Actual level lo								
Internal Temperature Calibration	Word	25	Volt equivalent for Ambient temperature set during calibration	821	-	0	Internal factory setting for internal temperature sensor calibration	Internal parameter only	Factory	Read Only	
AD5421 Calibration	Word	26	AD5421 Offset value	0x89D9	0xFFFF	0	Internal factory calibration settings for 4 - 20mA AD	Internal parameter only	Factory	Read Only	

AD5421 Calibration	Word	27	AD5421 Gain value	0xC4ED	0xFFFF	0	conversion	Internal parameter only	Factory	Read Only	
Number of decimal points for level values	Word	28	Decimal points - Level	1	3	0	This factory set register defines the number of decimal places that the APT1000 is factory calibrated to. It is set at a value of 1 which means the calbiration is to a resolution of 0.1mm H2O. It is also used as a scaling factor for integer values which are entered into or held in the following registers. Pressure Calibration - registers 442 to 451, Actual Pressure - registers 4 & 5, Actual Level - registers 23 & 24, mA Zero value - registers 104 & 105, mA Span value - registers 106 & 107 , Min Pressure - registers 35 & 36, Max Pressure- registers 33 & 34, Liquid Level - registers 7 & 8, and Pressure Offset - registers 40 & 41. For all of these listed registers the appropriate decimal place should be inferred. For example a value of 1 in register 28 would mean that an integer value of 1000 had the actual meaning of 100.0	Internal parameter only	Factory	Read Only	Firmware Versions prior to 6.7 are user accessible but MUST NOT be changed
Internal Temperature Calibration (Con't)	Word	29	Ambient temperature	250	-	0	Internal factory calibration setting for internal temperature sensor	Internal parameter only	Factory	Read Only	
Status Register	Word	30	Status Register	0	31	0	This status of bits in this register identifies if errors have been detected. Some, depending whether they are enabled (in register 31) can also force the mA output to a fixed value. Bit 0 is set when a negative level is detected. This parameter is for information only and should NOT be used to force the analogue outpt to a fault value. Bit 1 is set if the sensor reads a pressure input higher than the accepted maximum of 70000mm. If enabled in register 31 the mA output is driven to the 21mA fault condition. Bit 2 is not used, it is reserved for future use. Bit 3 is set to indicate that the percentage level calculated has exceeded 100%. If it is set and the value exceeds the tolerance percentage value specified in register 42 the mA output will drive to 21mA if this is enabled in register 31. Bit 4 is set if the percentage volume calculated has exceeded 100%. It will not trigger any fault current. Bit 5 is set when the percentage level calculated is less than 0%. If set and the value is lower than the tolerance percentage value specified in register 42 the mA output will drive to 3.2mA if this is enabled in register 31.	Error status flags	Factory	Read Only	
	Word	31	Status register mask	42	127	0	The settings in this register determine which of the error status conditions identified in register 30 trigger the mA fault signal. Note that the mA fault signal is only active for as long as the relevant error is present. If the error bit clears the mA signal will revert to normal operation. Note that the bits identified in register 30 are read from the most significant bit, i.e. this register would have a value of 0100000000000000 where Bit 1 is required to drive the mA signal to 21mA. **The default value is 0101010000000000**	Enable mA fault current conditions	User	Read / Write Access	

Manufacturing Mode Access	Word	32	Manufacturing mode passkey	-	-	-	For factory use only	Internal parameter only	Factory	No Access
Min/Max Recording	Word	33	Maximum pressure hi	The pressure values can range from -2,147,483,648 to 2,147,483,647.			Records the maximum pressure measured by the sensor during its operational lifetime. Value is stored as an integer but actual meaning is defined according to the decimal place setting in register 28	Stored maximum pressure history	Factory	Read Only
	Word	34	Maximum pressure lo							
	Word	35	Minimum pressure hi	The pressure values can range from -2,147,483,648 to 2,147,483,647.			Records the minimum pressure recorded by the sensor during its operational lifetime. Value is stored as an integer, but actual meaning is defined according to the decimal place setting in register 28	Satored minimum pressure history	Factory	Read Only
	Word	36	Minimum pressure lo							
	Word	37	Maximum temperature	-	-	-	Records in °C the maximum temperature recorded by the sensor during its operational lifetime. Value is stored as an integer with one decimal place impied. e.g. 80 °C would be recorded as 800	Stored minimum temperature history	Factory	Read Only
	Word	38	Minimum temperature	-	-	-	Records in °C the minimum temperature recorded by the sensor during its lifetime. Value is stored as an integer with one decimal place impied. e.g. 5 °C would be recorded as 50	Stored minimum temperature history		
Percentage range offset	Word	39	Percentage range offset	0	10000	0	This register is only relevant if the value of register 250 is set to 0 or 1 to relate the mA output to either % level or % volume. If used it defines the percentage value for either level or volume for which the APT1000 will output 20 mA. The value entered has the decimal point fixed to 2 places, e.g. enter 5000 for 50.00%.	mA output scaling value - depending on setting of register 250	User	Read / Write Access
Sensor Offset	Word	40	Pressure Trim Hi	The pressure values can range from -2,147,483,648 to 2,147,483,647.			This register allows a millimetres offset to be added to the pressure the APT1000 is reading. i.e. the Actual MV (address 4 & 5). All parameters which are calculated using the Actual MV value will then use Actual MV plus the value stored in this register. One example of it's use would be to correct a zero offset error on the APT1000. The value may be positive or negative. Enter the value as an integer. It's actual value will be determined by the number of decimal places set by register 28. For example if register 28 is set as 1 then 12345 will have the meaning 1234.5	mm Offset value to be added to raw pressure input from APT1000	User	Read / Write Access
	Word	41	Pressure Trim Lo							
Alarm Tolerance	Word	42	Alarm Tolerance Percentage	500	-10000	10000	If the mA output is set in register 31 to go to a fault state where the percentage level calculation returns a value either less than 0% or more than 100% , this will only happen if the percentage value calculated also exceeds the alarm tolerance specified in this register. e.g. if percentage level value is calculated as 103% and tolerance is set to 5% in this register then the status register (30) will indicate a tank level percentage overflow condition and the percentage level register (13 & 14) will be clamped to 100% but no fault current output will be triggered even if status mask register (31) enables it. If however, the percentage level is calculated at 106%, the percentage level register will remain clamped at 100%, status register 30 will have the status bit set and the fault current will be now be triggered - if status mask 31 enables it. The setting of this register applies both to the low state (below 0%) and the high state (above 100%). The value is entered as an integer with 2 decimal places fixed, e.g. 5.00% entered as 500	Alarm tolerance for out of limits paramters (to determine if fault current is enabled)	User	Read / Write Access
Uncompensated Actual MV	Word	47	Uncompensated Actual MV Hi	The pressure values can range from			The register shows the actual MV value calculated	Actual MV before Temperature compensation	Factory	Read Only

Uncompensated Actual MV	Word	48	Uncompensated Actual MV Lo	-2,147,483,648 to 2,147,483,647.			without performing temperature compensation	Actual MV before Temperature compensation	Factory	Read Only
Actual MV Override	Word	49	Actual MV Override Hi	The pressure values can range from -2,147,483,648 to 2,147,483,647.			For factory testing only. The values entered into these registers are used to replace the actual MV. The purpose is to enable Factory testing of the Temperature compensation. For normal operation these registers must be set to 0	Simulation of MV for Temp Comp testing	Factory	Read Only
	Word	50	Actual MV Override Lo							
Temperature Override	Word	51	Temperature override	-	-	-	For Factory testing only. The value entered into this register is used to replace the actual temperature read by the device. The purpose is to enable Factory testing of the Temperature compensation. For normal operation the register must be set to 0	Temperature reading simulation	Factory	Read Only
RS 485 Termination resistor	Bit	53	RS 485 internal termination resistor control	0	1	0	If set to 1 the termination resistor for RS 485 is enabled. If set to 0 the termination resistor is disabled.	Enable / disable RS485 Terminating resistor	User	Read / Write Access
4-20mA Output Scaling	Word	104	Zero point pressure hi	The pressure values can range from -2,147,483,648 to 2,147,483,647.			The settings in this register are only considered if register 250 is set to 3. They define the actual pressure value (from register 4 & 5) that corresponds to 4mA output. It is entered as an integer but it's actual value is defined according to the decimal place setting in register 28	Pressure value for 4mA output (only if ragister 250 is set to 2)	User	Read / Write Access
	Word	105	Zero point pressure lo							
	Word	106	Span point pressure hi				The settings in this register are only considered if register 250 is set to 3. They define the actual pressure value (from register 4 & 5) that corresponds to 20mA analogue output. It is entered as an integer but it's actual value is defined according to the decimal place setting in register 28	Pressure value for 20mA output (only if ragister 250 is set to 2)	User	Read / Write Access
	Word	107	Span point pressure lo							
Tank look-up table	Word	143	Profile points used	25	25	0	Number of points to be used from the tank look-up table, a maximum of 25 points can be used. See registers 144 to 243. If the tank is linear such that the percentage leval and percentage volume track each other identcally it is acceptable to use only 2 data points, a pair at 0% and a pair at 100%	Tank Look up table % level point	User	Read / Write Access
	Word	144	%level look-up point 1 hi	Linear Table	10000	#REF!	Entry of up to 25 LEVEL data points (as defined by register 143) for the tank look-up. Table Point 1 (registers 144 & 145) being the lowest level. Value is entered as percentage level in an integer value to 2 decimal places. E.g. 51.26% level would be entered as 5126. The values entered must increase from the previous register. The final value must be 100.00% entered as 10000. If there are any unused points, then the value of register 143 must be reduced to the actual number of points, or unused data points must be entered as 100.00%, i.e. 10000	Tank Look up table % level point	User	Read / Write Access
	Word	145	%level look-up point 1 lo					Tank Look up table % level point		
	Word	146 to 191	%level look-up points 2 to 24					Tank Look up table % level point		
	Word	192	%level look-up point 25 hi					Tank Look up table % level point		
	Word	193	%level look-up point 25 lo					Tank Look up table % level point		
	Word	194	%volume look-up point 1 hi		10000		Entry of up to 25 VOLUME data Points for the corresponding % volume at the % level points entered between registers 144 to 193. Table point 1 (registers 194 & 195) being the lowest volume at lowest level (registers 144 & 145). The values entered must increase from the previous register. The final value must be 100.00% entered as 10000. If there are any unused points, then the value of register 143 must be reduced to the actual number of points, or unused data points must be entered as 100.00%, i.e. 10000	Tank Look up table % volume point	User	Read / Write Access
	Word	195	%volume look-up point 1 lo					Tank Look up table % volume point		
	Word	196 to 241	%volume look-up points 2 to 24					Tank Look up table % volume point		
	Word	242	%volume look-up point 25 hi					Tank Look up table % volume point		
	Word	243	%volume look-up point 25 lo					Tank Look up table % volume point		

User Filter	Word	249	User filter value	1	1200	1	Averaging is performed according to the value of this register (n). In operation this means that the APT1000 will take the value of "n" samples summate them and divide by n to obtain an averaged value. Minimum value is 1 maximum value is 1200. Internal samples are taken every 90 m/sec so for example a setting of 20 will give an update rate of approximately 1.8 seconds	Filter value (signal averaging)	User	Read / Write Access
Analogue Output Source Selection	Word	250	Analogue output source	3	5	0	This register defines which parameter the 4-20mA analogue output signal represents. 0 = % of tank volume - based on registers 20 & 21 1 = % of tank level - based on registers 13 & 14 2 = Scaled pressure - based on registers 104 to 107 3 = Actual pressure based on register 4 & 5 where 4mA is defined as calibration pressure point 1 - registers 442 & 443, and 20mA is defined as calibration pressure point 5 registers 450 & 451 4 = analogue output is off - fixed at 3.2mA 5 = Forced output. This allows for testing of the mA output and connected instruments by driving the mA output to a fixed value (defined in register 263)	4-20mA output scaling parameter	User	Read / Write Access
Forced Output	Word	263	Forced analogue output percentage	0	10000	0	This register is used to set the value of the mA output when the "forced analogue output mode" is selected in analogue output source (register 250). Enter as a percentage of 4-20mA output with fixed 2 decimal places e.g. 50.00% is entered as 5000.	Manual setting of mA value for test purposes	User	Read / Write Access
Temperature compensation coefficient	Word	299	Resolution	6	6	0	The register decides the accuracy of the temeprature coefficients entered. The part of the temperature coefficient after the decimal point is made into a n decimal place accurate value, where n is the value stored in the resolution register.	temperature compensation resolution	Factory	Read Only
	Word	300	Temperature coefficient 1_0 Integer part Hi (a01 h)	Values can vary from-2,147,483,648 to 2,147,483,647			Coefficients used for temperature compensation.	Temperature compensation coefficients	Factory	Read Only
	Word	301	Temperature coefficient 1_0 Integer part Lo (a01 l)							
	Word	302	Temperature coefficient 1_0 Decimal part Hi (a01 dh)							
	Word	303	Temperature coefficient 1_0 Decimal part Lo (a01 dl)							
	Word	304 to 379	4 coefficients per point for 5 points							
Sensor calibration	Word	400	ADC output calibration point 1 hi	-	-	-	Internal Factory set parameters for Five point ADC calibration	Internal parameter only	Factory	Read Only
	Word	401	ADC output calibration point 1 lo	-	-	-		Internal parameter only		
	Word	402	Point 2	-	-	-		Internal parameter only		
	Word	403		-	-	-		Internal parameter only		
	Word	404	Point 3	-	-	-		Internal parameter only		
	Word	405		-	-	-		Internal parameter only		
	Word	406	Point 4	-	-	-		Internal parameter only		
	Word	407		-	-	-		Internal parameter only		
	Word	408	Point 5	-	-	-		Internal parameter only		
	Word	409		-	-	-		Internal parameter only		
	Word	442	Pressure calibration point 1 hi	The pressure values can range from -2,147,483,648 to 2,147,483,647.			Internal stored parameters for factory pressure calibration. Values stored as integer with 3 decinal places implied. i.e. 5000000 means 5000.000	Internal parameter only	Factory	Read Only
	Word	443	Pressure calibration point 1 lo					Internal parameter only		
	Word	444	Point 2					Internal parameter only		
	Word	445						Internal parameter only		
	Word	446	Point 3					Internal parameter only		
	Word	447						Internal parameter only		
	Word	448	Point 4					Internal parameter only		

	Word	449	Point 4					Internal parameter only		
	Word	450	Point 5					Internal parameter only		
	Word	451						Internal parameter only		
Manufacturer Details	Word	1000	Serial Number	0	4294967295	0	Unique factory set Customer instrument serial number	Factory set Serial Number	Factory	Read Only
	Word	1001								
	Word	1004	Firmware version	-	-	-	Firmware version. Shown as integer with one decimal place implied i.e. 65 means 6.5	Firmware Version	Factory	Read Only
	Word	1005	Factory Serial Number	0	4294967295	0	Internal factory serial number	Internal parameter only	Factory	Read Only
	Word	1006								
	Word	1007	PCB GRN	0	4294967295	0	Factory record: PCB Batch	Internal parameter only	Factory	Read Only
	Word	1008								
	Word	1009	Sensor nominal range	0	4294967295	0	Factory record: Nominal range of element	Internal parameter only	Factory	Read Only
	Word	1010								
Sensor Type	Word	1011	Sensor type	1	3	1	Factory record: Sensor type 1 = Gauge 2 = Absolute 3 = Compound	Internal parameter only	Factory	Read Only
User Defined Units	Word	1012	User unit characters 1 & 2	-	-	-	Free format entry up to a maximum 20 characters	User configured name for Sensor / Duty	User	Read / Write Access
	Word	1013	User unit characters 3 & 4	-	-	-		User configured name for Sensor / Duty		
	Word	1014	User unit characters 5 & 6	-	-	-		User configured name for Sensor / Duty		
	Word	1015	User unit characters 7 & 8	-	-	-		User configured name for Sensor / Duty		
	Word	1016	User unit characters 9 & 10	-	-	-		User configured name for Sensor / Duty		
	Word	1017	User unit characters 11 & 12	-	-	-		User configured name for Sensor / Duty		
	Word	1018	User unit characters 13 & 14	-	-	-		User configured name for Sensor / Duty		
	Word	1019	User unit characters 15 & 16	-	-	-		User configured name for Sensor / Duty		
	Word	1020	User unit characters 17 & 18	-	-	-		User configured name for Sensor / Duty		
	Word	1021	User unit characters 19 & 20	-	-	-		User configured name for Sensor / Duty		
Customer tagging	Word	1022	Customer tagging 1 & 2	-	-	-	Free format entry up to a maximum 20 characters	User configured name for Sensor / Duty	User	Read / Write Access
	Word	1023	Customer tagging 3 & 4	-	-	-		User configured name for Sensor / Duty		
	Word	1024	Customer tagging 5 & 6	-	-	-		User configured name for Sensor / Duty		
	Word	1025	Customer tagging 7 & 8	-	-	-		User configured name for Sensor / Duty		
	Word	1026	Customer tagging 9 & 10	-	-	-		User configured name for Sensor / Duty		
	Word	1027	Customer tagging 11 & 12	-	-	-		User configured name for Sensor / Duty		
	Word	1028	Customer tagging 13 & 14	-	-	-		User configured name for Sensor / Duty		
	Word	1029	Customer tagging 15 & 16	-	-	-		User configured name for Sensor / Duty		
	Word	1030	Customer tagging 17 & 18	-	-	-		User configured name for Sensor / Duty		
	Word	1031	Customer tagging 19 & 20	-	-	-		User configured name for Sensor / Duty		
Actual Calibrated Range	Word	1032	Sensor Actual Calibrated Range hi	-	-	-	Factory note: Record of Sensor actual calibrated range in millimetres H2O.	Internal parameter only	Factory	Read Only
	Word	1033	Sensor Actual Calibrated Range lo	-	-	-				

Dafault Value Table for Level and Volume look up Table			
	%Lvl	%Vol	Actual Value stored in register
1	0	0	0
2	5	5	500
3	10	10	1000
4	15	15	1500
5	20	20	2000
6	25	25	2500
7	30	30	3000
8	35	35	3500
9	40	40	4000
10	45	45	4500
11	50	50	5000
12	55	55	5500
13	60	60	6000
14	65	65	6500
15	70	70	7000
16	75	75	7500
17	80	80	8000
18	85	85	8500
19	90	90	9000
20	95	95	9500
21	100	100	10000
22	100	100	10000

23	100	100	10000
24	100	100	10000
25	100	100	10000