EMERSON
Industrial Automation

Application Note
CTSL #013

This Application Note is pertinent to the Unidrive SP, Mentor MP, Commander SK
Affinity and Commander GP20 using SyPT Lite

Extending the I/O Status Word

Introduction

On occasion, when using Fieldbus communications such as DeviceNet, Profibus, BacNet or Ethernet, the host computer may request the state of the Inputs presented to the drive. These inputs may or may not be being used by the drive but could merely be a method of acquiring remote input status logically associated with a given drive section on a machine.

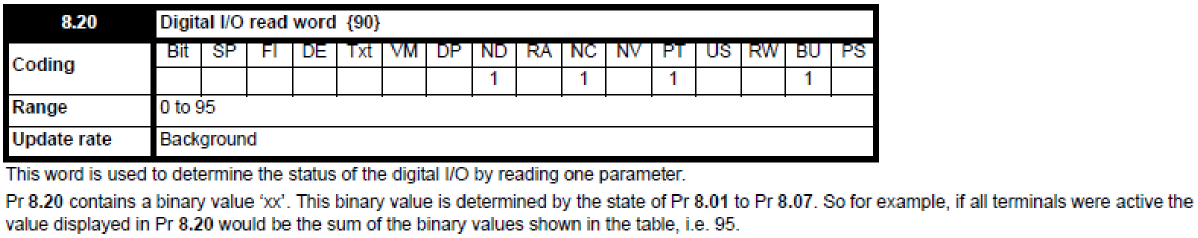
Utilization of this "**remote distributed I/O**", could prove to be a very economical technique. When a Fieldbus is being used, the drive is often controlled using the Control Word, therefore it's built-in I/O is not being used. In this case, all this remote I/O is free and going to waste. If the system designer wished to put this I/O to work, he/she would place the drives I/O Status word into the cyclic transfers list for quick access and use by the communication master. This status word often has unused bits in its' word which could be extended if need be.

This application note will use the free PLC software toolkit called SyPT Lite that can be utilized by our Unidrive SP, Commander SK , Mentor MP, Affinity and GP20 drives to illustrate exactly how to append a bit to the existing status word of the drive.

To obtain your free copy of SyPT Lite simply click here→ **SyPT Lite** Free

The I/O Status Word

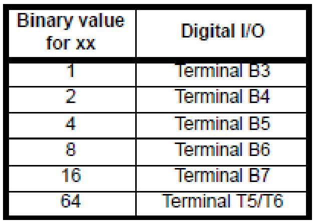
In Commander SK, the I/O Status Word, parameter #8.20, provides the state of the drives I/O condensed in one binary word as illustrated below.



8.20	Digital I/O read word {90}															
Coding	Bit	SP	FI	DE	Txt	VM	DP	ND	RA	NC	NV	PT	US	RW	BU	PS
								1		1		1			1	
Range	0 to 95															
Update rate	Background															

This word is used to determine the status of the digital I/O by reading one parameter.

Pr **8.20** contains a binary value 'xx'. This binary value is determined by the state of Pr **8.01** to Pr **8.07**. So for example, if all terminals were active the value displayed in Pr **8.20** would be the sum of the binary values shown in the table, i.e. 95.

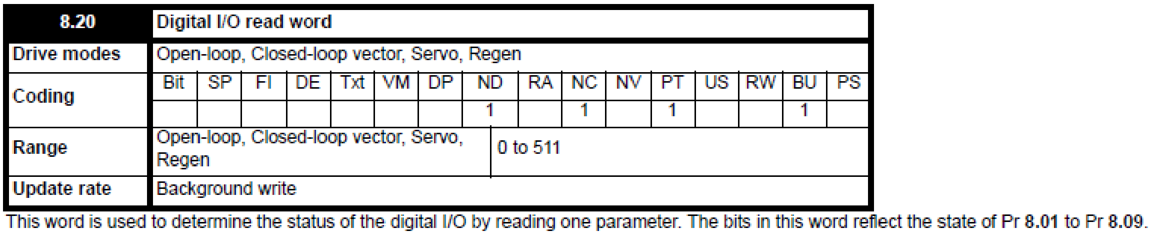


Binary value for xx	Digital I/O
1	Terminal B3
2	Terminal B4
4	Terminal B5
8	Terminal B6
16	Terminal B7
64	Terminal T5/T6

Example

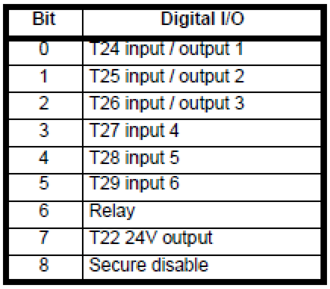
If one reads #8.20 and found a 66_{10} ,which is $100\ 0010_2$, this would indicate that terminal B4 is active and the drive relay with closes a contact on T5 and T6 is also active.

For Unidrive SP, Affinity and GP20, parameter #8.20 is defined as shown below.



8.20	Digital I/O read word															
Drive modes	Open-loop, Closed-loop vector, Servo, Regen															
Coding	Bit	SP	FI	DE	Txt	VM	DP	ND	RA	NC	NV	PT	US	RW	BU	PS
								1		1		1			1	
Range	Open-loop, Closed-loop vector, Servo, Regen	0 to 511														
Update rate	Background write															

This word is used to determine the status of the digital I/O by reading one parameter. The bits in this word reflect the state of Pr **8.01** to Pr **8.09**.



Bit	Digital I/O
0	T24 input / output 1
1	T25 input / output 2
2	T26 input / output 3
3	T27 input 4
4	T28 input 5
5	T29 input 6
6	Relay
7	T22 24V output
8	Secure disable

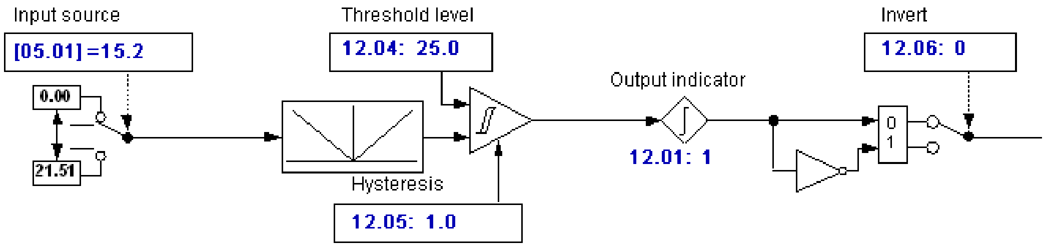
Extending the Status Word

As one can see, the 16bit Status Word is only partially used. There are several free bits available to include other items should you desire.

For instance, suppose one would want to know when the drive was supplying a frequency greater than 25% of the set maximum to the motor it is driving.

This could easily be determined by using one of the built-in Comparators available in Menu 12. From this example, we are monitoring #5.01 which is the drives output frequency. Setting the threshold level at 25% we can see that #12.01 indicates when the drive output is above 15Hz (25% of the 60Hz maximum setting).

Threshold detector 1

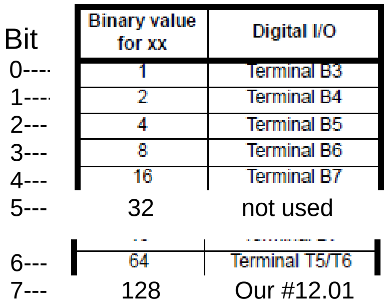


But how do we get this bit, #12.01 into our Status Word ?

This is where SyPT Lite will come into play for us.

If we use the Commander SK I/O Status Word :

Note however, **Bit 5 (**which is 32_{10} **) has been skipped**



Bit	Binary value for xx	Digital I/O
0---	1	Terminal B3
1---	2	Terminal B4
2---	4	Terminal B5
3---	8	Terminal B6
4---	16	Terminal B7
5---	32	not used
6---	64	Terminal T5/T6
7---	128	Our #12.01

If we could add a bit to the next available bit position, bit 7 – this would add a 128 bit (2^7 =128) if #12.01 is a 1 and conversely take away the 128 bit if #12.01 is a 0.

In order to achieve this, we would **OR** the original Status Word with the bit pattern shown below:

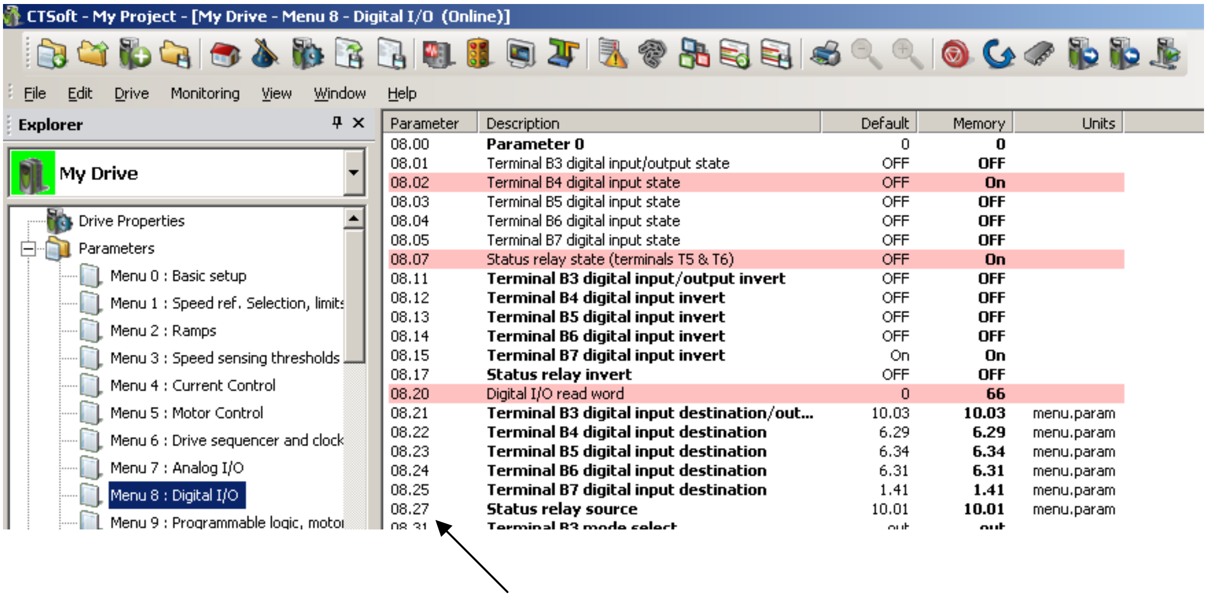
Bit------→ **7654 3210**
$1000\ 0000_2$ which = 128_{10}

this would add a bit 7 or 128 bit if #12.01 is a 1

Likewise we would **AND** the original Status Word with the bit pattern shown below if #12.01=0. This would “mask off” bit 7. Note we could also mask off bit 5 as it is not used in the Commander SK I/O Status word. (We could elect to use a mask of 127_{10} if we assume bit 5 will never become a 1).

Bit------→ **7654 3210**
$0101\ 1111_2$ which = 95_{10}

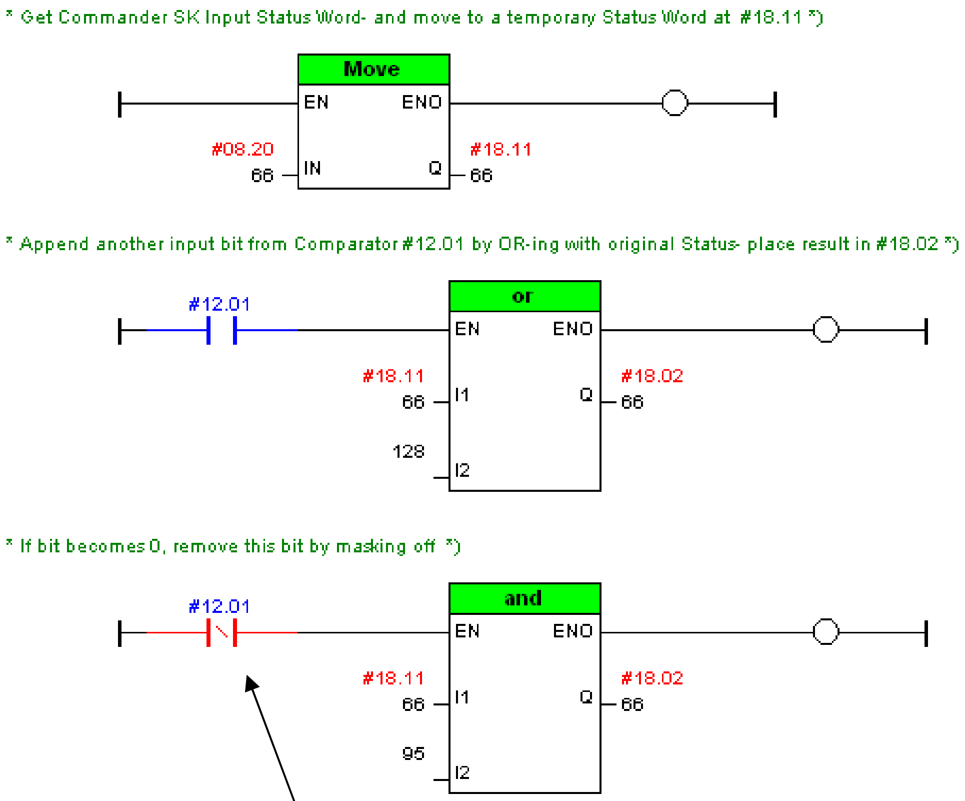
From the CTSoft screenshot below we see that terminal B4 is active and the Relay at terminal T5 & T6 is on (since #8.27 is set for #10.01= Drive Healthy), which results in 66_{10} (or 1000010_2 =64+2) at #8.20.


CTSoft - My Project - [My Drive - Menu 8 - Digital I/O (Online)]
File
Edit
Drive
Monitoring
View
Window
Help
Explorer
My Drive
Drive Properties
Parameters
Menu 0 : Basic setup
Menu 1 : Speed ref. Selection, limits
Menu 2 : Ramps
Menu 3 : Speed sensing thresholds
Menu 4 : Current Control
Menu 5 : Motor Control
Menu 6 : Drive sequencer and clock
Menu 7 : Analog I/O
Menu 8 : Digital I/O
Menu 9 : Programmable logic, motor

Parameter	Description	Default	Memory	Units
08.00	**Parameter 0**	0	**0**	
08.01	Terminal B3 digital input/output state	OFF	**OFF**	
08.02	Terminal B4 digital input state	OFF	**On**	
08.03	Terminal B5 digital input state	OFF	**OFF**	
08.04	Terminal B6 digital input state	OFF	**OFF**	
08.05	Terminal B7 digital input state	OFF	**OFF**	
08.07	Status relay state (terminals T5 & T6)	OFF	**On**	
08.11	**Terminal B3 digital input/output invert**	OFF	**OFF**	
08.12	**Terminal B4 digital input invert**	OFF	**OFF**	
08.13	**Terminal B5 digital input invert**	OFF	**OFF**	
08.14	**Terminal B6 digital input invert**	OFF	**OFF**	
08.15	**Terminal B7 digital input invert**	On	**On**	
08.17	**Status relay invert**	OFF	**OFF**	
08.20	Digital I/O read word	0	**66**	
08.21	**Terminal B3 digital input destination/out...**	10.03	**10.03**	menu.param
08.22	**Terminal B4 digital input destination**	6.29	**6.29**	menu.param
08.23	**Terminal B5 digital input destination**	6.34	**6.34**	menu.param
08.24	**Terminal B6 digital input destination**	6.31	**6.31**	menu.param
08.25	**Terminal B7 digital input destination**	1.41	**1.41**	menu.param
08.27	**Status relay source**	10.01	**10.01**	menu.param
08.31	**Terminal B3 mode select**	out	**out**	

It should be noted that in this example we could have cheated….. if the relay on T5/T6 were not being used for anything, we could simply set #8.27 = 12.01 and the I/O Status word would then reflect the state of #12.01 within bit 6 of the original #8.20 word. But then we wouldn’t need a SyPT Lite program to accomplish this - this would have certainly simplified this Application Note example.

Our SyPT Lite Program to Append our new bit

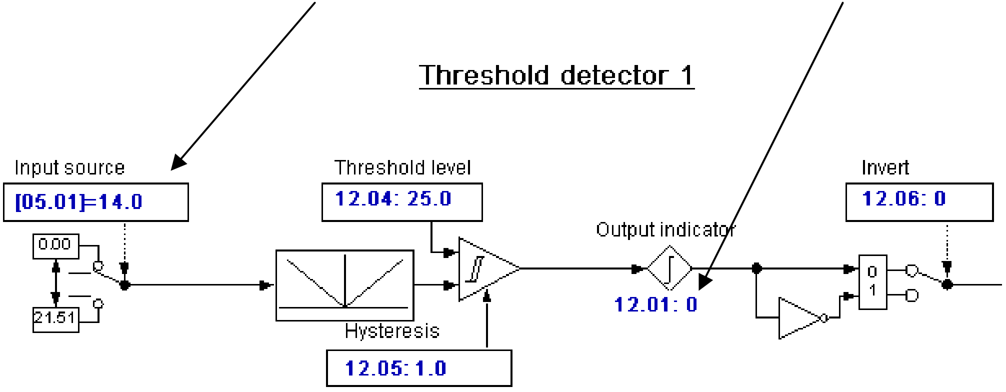


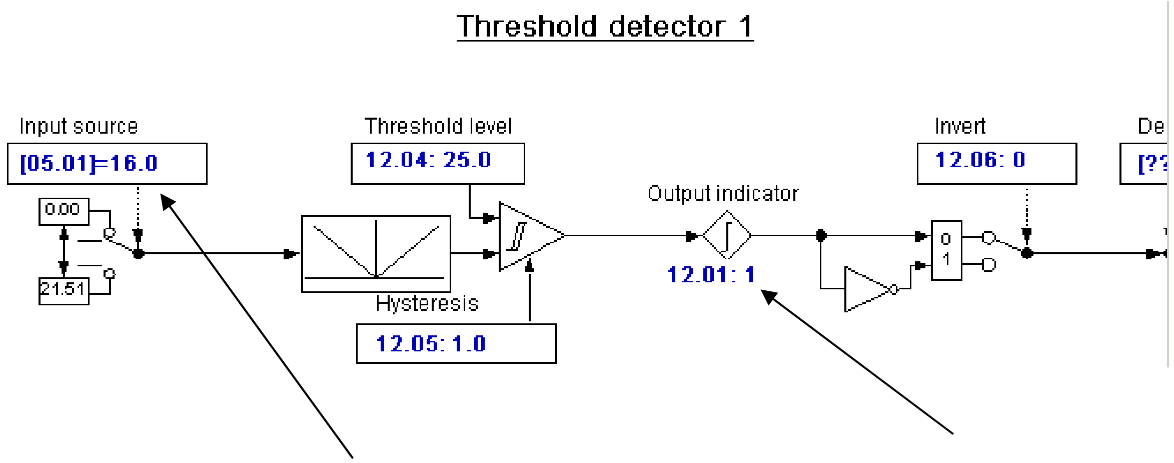
(* Get Commander SK Input Status Word- and move to a temporary Status Word at #18.11 *)

(* Append another input bit from Comparator #12.01 by OR-ing with original Status- place result in #18.02 *)

(* If bit becomes 0, remove this bit by masking off *)

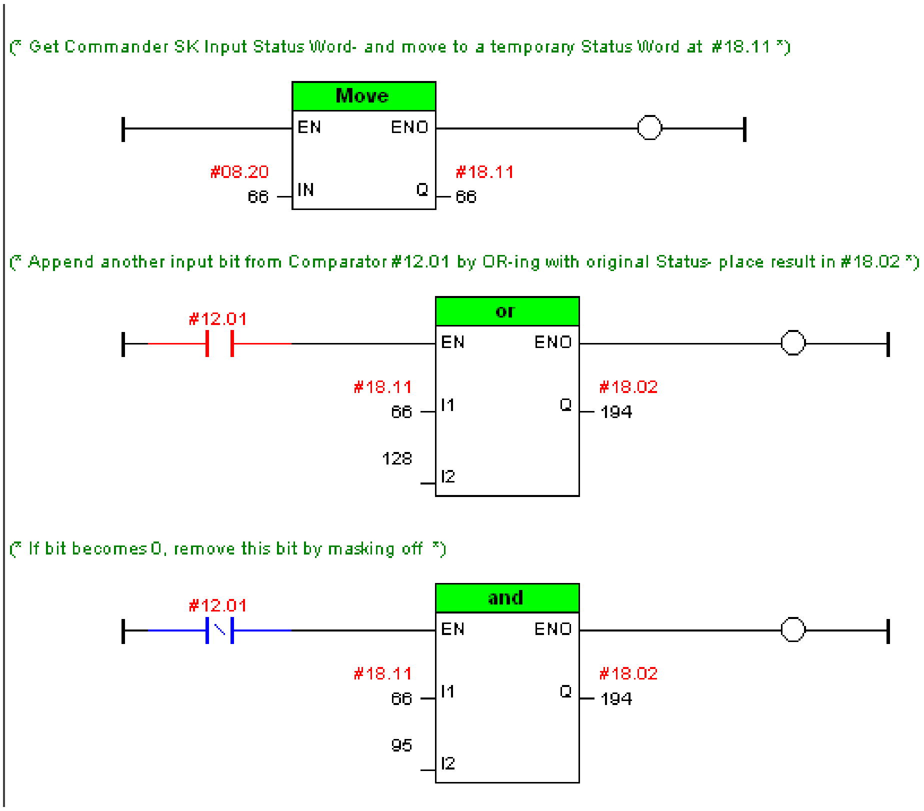
Since our drive frequency is below our 25% or 15Hz threshold, #12.01 is a 0 which executes the **AND** rung directly above which preserves the original status word information.





However, when our drive frequency is above our 25% or the 15Hz threshold, #12.01 becomes a 1 which executes the **OR** rung below which appends 128 to the original status word information-

66_{10} (0100 0010_2) OR'd with 128_{10} = 194_{10} which= 1100 0010_2
^-------------------------- ^


(* Get Commander SK Input Status Word- and move to a temporary Status Word at #18.11 *)

(* Append another input bit from Comparator #12.01 by OR-ing with original Status- place result in #18.02 *)

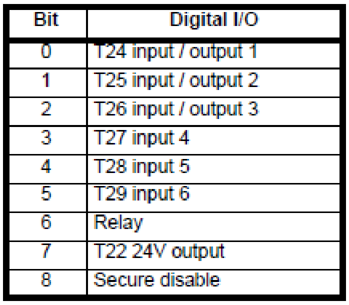
(* If bit becomes 0, remove this bit by masking off *)

In this manner, a Fieldbus host can read and decode the new I/O Status Word placed and #18.02 in our example program above, and pick up our new added bit in the bit 7 position.

To obtain this code fragment above for Commander SK example click → CTSL013a.dpl

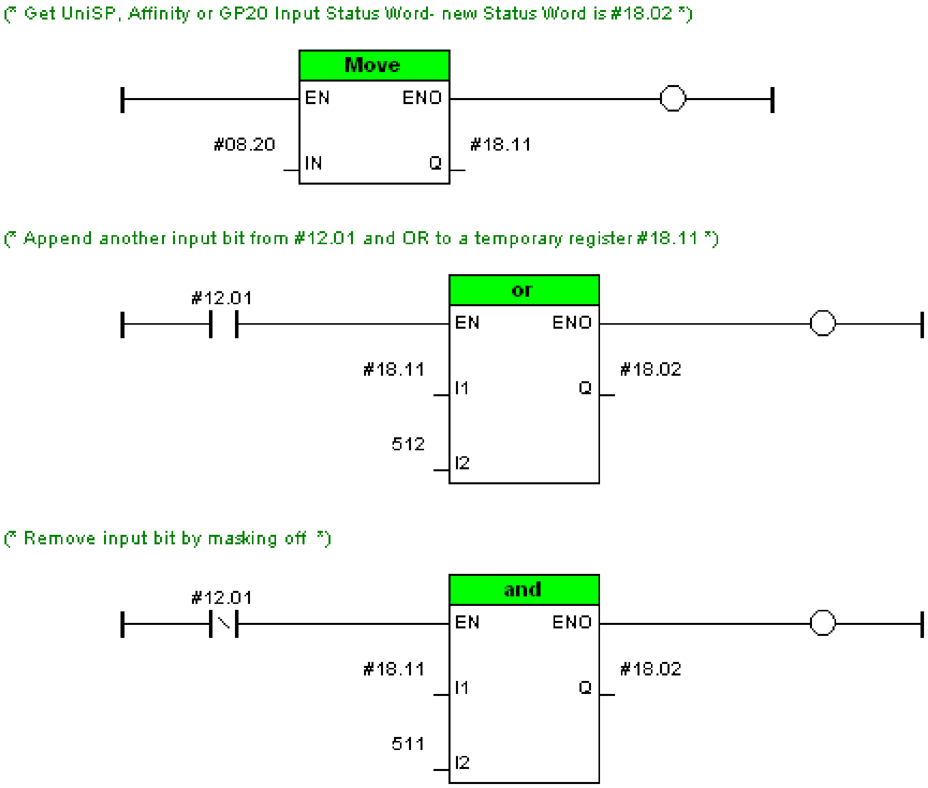
For Unidrive SP, Affinity or GP20

The same procedures would be used but the **OR** and **AND** words would obviously be different because #8.20 layout is quite different.



Bit	Digital I/O
0	T24 input / output 1
1	T25 input / output 2
2	T26 input / output 3
3	T27 input 4
4	T28 input 5
5	T29 input 6
6	Relay
7	T22 24V output
8	Secure disable

If we added another bit it would become bit 9 which would be 2^9 or 512_{10} for the **OR** word and 511_{10} for the **AND** mask.



(* Get UniSP, Affinity or GP20 Input Status Word- new Status Word is #18.02 *)

(* Append another input bit from #12.01 and OR to a temporary register #18.11 *)

(* Remove input bit by masking off *)

In this manner, a Fieldbus host can read and decode the new I/O Status Word placed and #18.02 in our example program above, and pick up our new added bit in the bit 9 position.

To obtain this code fragment above for Commander SK example click → **CTSL013b.dpl**

Sometimes you just need 1 more input to make the application complete and you would like that input to be part of the I/O Status word.

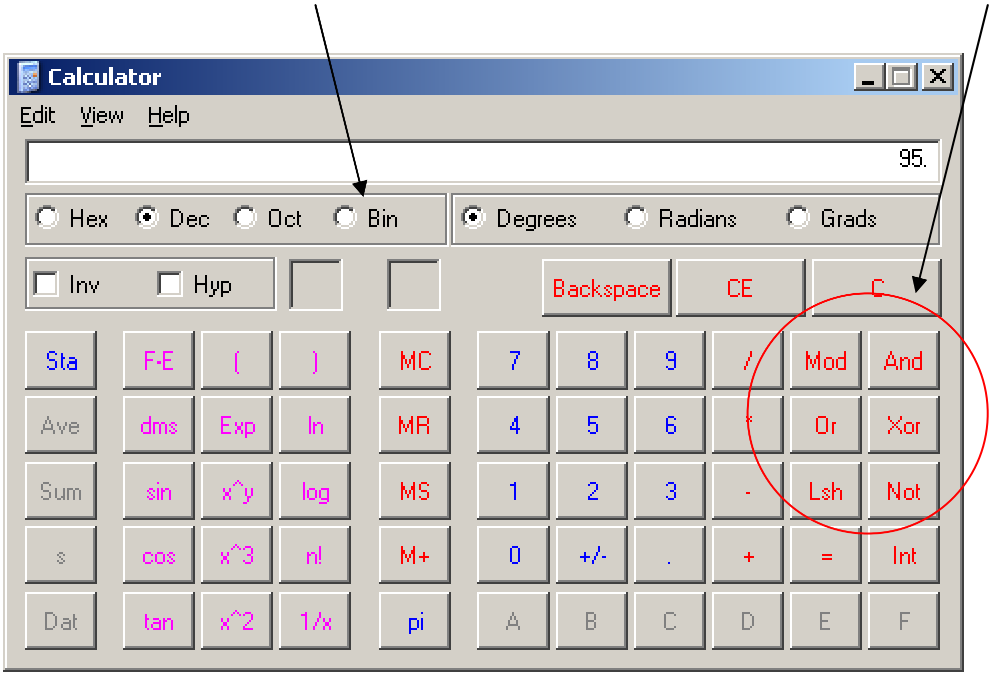
See CTAN275

Another application note that is on the topic:

Decoding the I/O Status Word → CTLS004

Binary to Decimal and Decimal to Binary Logical Operations

I find that the Scientific Calculator included with Window Accessories is quite helpful with Binary → Decimal and Decimal → Binary conversions. In addition, this calculator allows you to perform Boolean operations such as AND, OR, XOR etc.



95.

○ Hex ● Dec ○ Oct ○ Bin

● Degrees ○ Radians ○ Grads

□ Inv □ Hyp

The screenshots in this App Note are taken from CTSoft which is free from our website.

CTSoft is a complimentary software tool free for your use with Control Techniques Drives.

To obtain your Free Copy click below

Free

CTSoft and CT Comms Cable

Questions ?? Ask the Author:

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