UNIVERSIDADE DO ALGARVE

ESCOLA SUPERIOR DE TECNOLOGIA

ENGENHARIA ELÉCTRICA E ELECTRÓNICA

AUTÓMATOS PROGRAMÁVEIS

ROTEIRO PRÁTICO

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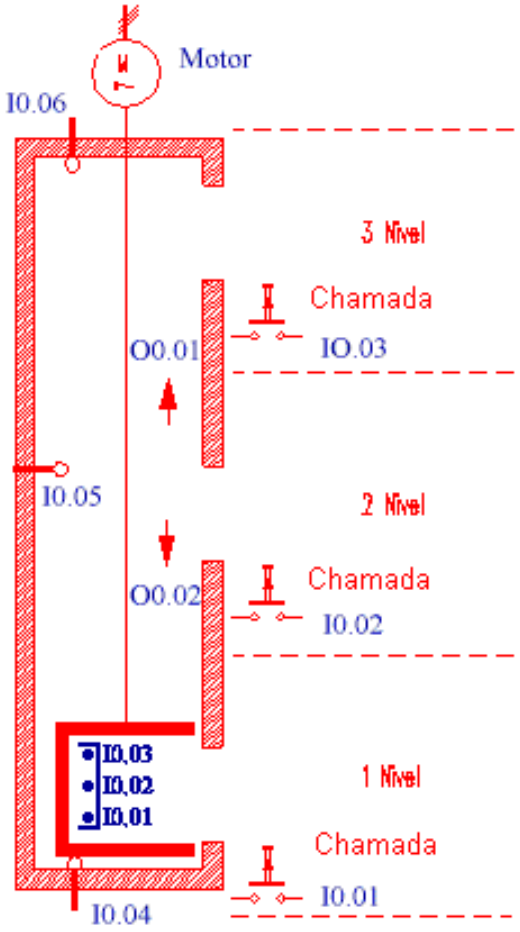
ÍNDICE

EXERCÍCIOS

1. GRAFCET

1.1

Elabore o GRAFET para controlo dos movimentos de subida e descida de um elevador, para um edifício de três pisos. Cada andar tem um botão para chamada do elevador. Os botões do interior elevador são ligados em paralelo com os botões que se encontram no exterior, pelo que não necessitam de programação.



1.2

Realize o GRAFCET associado a um sistema composto por um motor e um inversor de rotação: O sistema tem as seguintes condições de funcionamento:

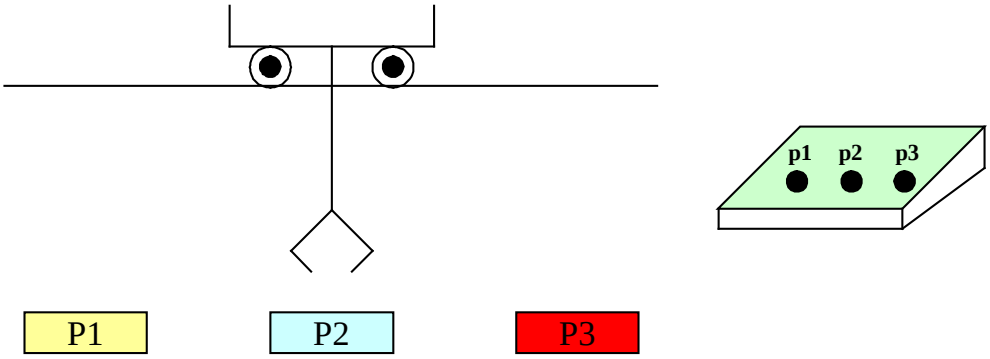
- Três botões de funcionamento: botão de rotação para a direita, botão de rotação para a esquerda e botão de paragem.
- Relé térmico: quando fechado pára o motor.
- A inversão do sentido de rotação do motor deve poder ser efectuada sem passar pelo botão de paragem, i.e., estando o motor a rodar num sentido, ao ser pressionado o botão de rotação inversa, o sistema pára automaticamente o motor e após esgotada uma certa temporização inverte o sentido de rotação.
- Ao ser pressionado o botão de paragem deve também ser gerada uma temporização antes de poder ser invertido o sentido de rotação do motor.

1.3

Considere um dispositivo de manipulação, podendo servir três postos **P1**, **P2** e **P3**. No repouso, o dispositivo está presente num dos três postos com a garra aberta. Existem três botões de pressão (**p1**, **p2** e **p3**) correspondentes a pedidos de transferência para um dos três postos. Quando o dispositivo está em repouso, o pedido de transferência para outro posto desencadeia a seguinte sequência:

- Fecho da garra (**FGarra**).
- Movimento à esquerda (**Esq**) ou à direita (**Dir**) de acordo com o pedido.
- Abertura da garra (**AGarra**) logo que o posto desejado é atingido.

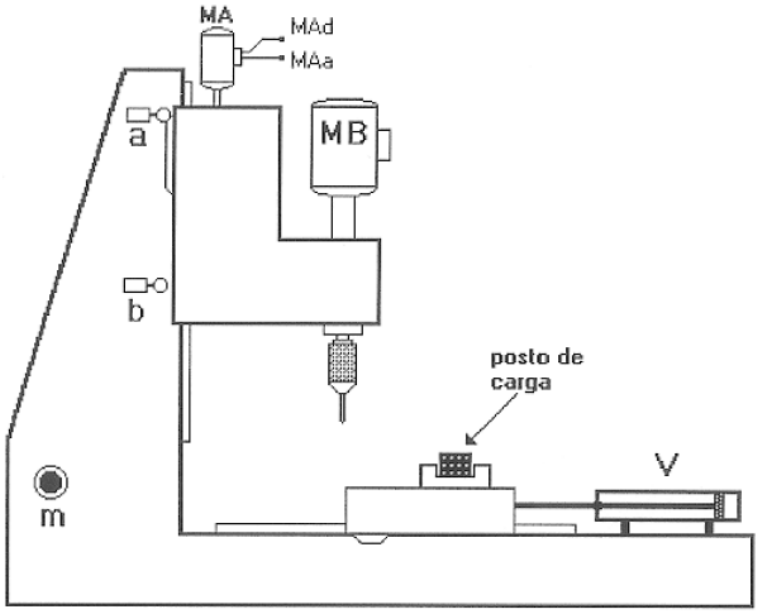
Em cada posto existe um sensor de posição: **S1**, **S2** e **S3**. O fecho total da garra é detectado pelo sensor **GF** e a abertura total detectada pelo sensor **GA**.



Para o dispositivo descrito elabore o GRAFCET e traduza-o para Diagrama de Contactos.

1.4

A figura seguinte representa um engenho de furar automático, sendo a sua parte eléctrica constituída por dois motores (**MA** e **MB**), um botão de pressão (**m**) e dois sensores de fim de curso (**a** e **b**). O motor **MB** destina-se a efectuar o movimento rotativo da broca e o motor **MA** destina-se a movimentar verticalmente a broca através dos movimentos **MAa** e **MAd**.



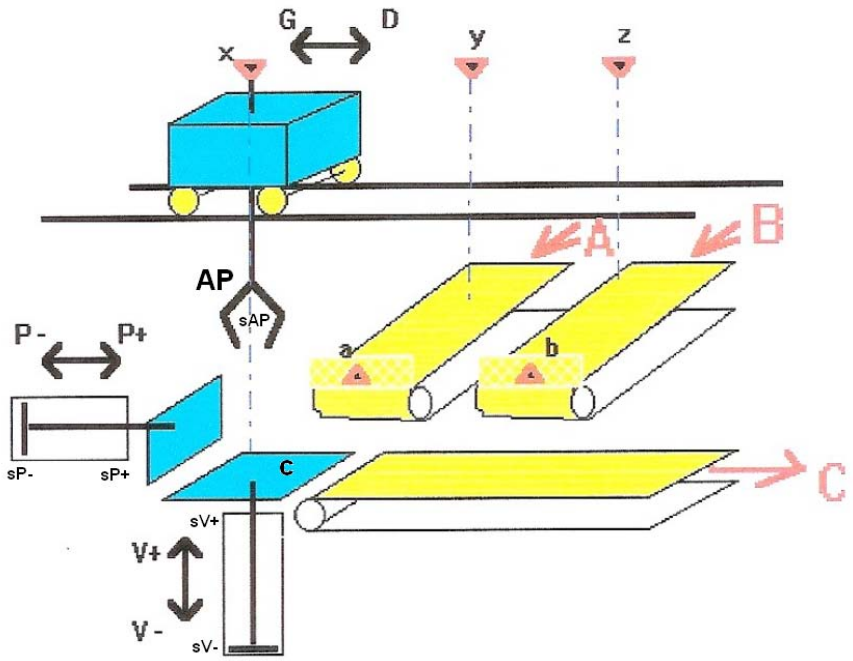
O modo de funcionamento é o seguinte:

- A peça a furar é colocada no posto de carga. Logo que o operador accione o botão de pressão **m**, o pistão **V** é accionado deslocando a peça para a posição de furacão.
- Após 3 segundos accionar o motor **MA** para descer a coluna até ao sensor b, altura em que **MA** é desligado.
- Após uma pausa de 2 segundos, **MA** é ligado em sentido contrário, subindo a coluna até ao sensor **a**, altura em que **MA** é desligado.
- Neste momento **V** é desligado, sendo retirada a peça do posto de carga.
- Para realizar a furação, o motor **MB** é ligado no arranque do movimento descendente, sendo só desligado quando o movimento ascendente terminar.

Implemente o GRAFCET para controlo do dispositivo descrito.

1.5

Elabore o GRAFCET e o correspondente Diagrama de Contactos para controlo do seguinte transportador de peças:



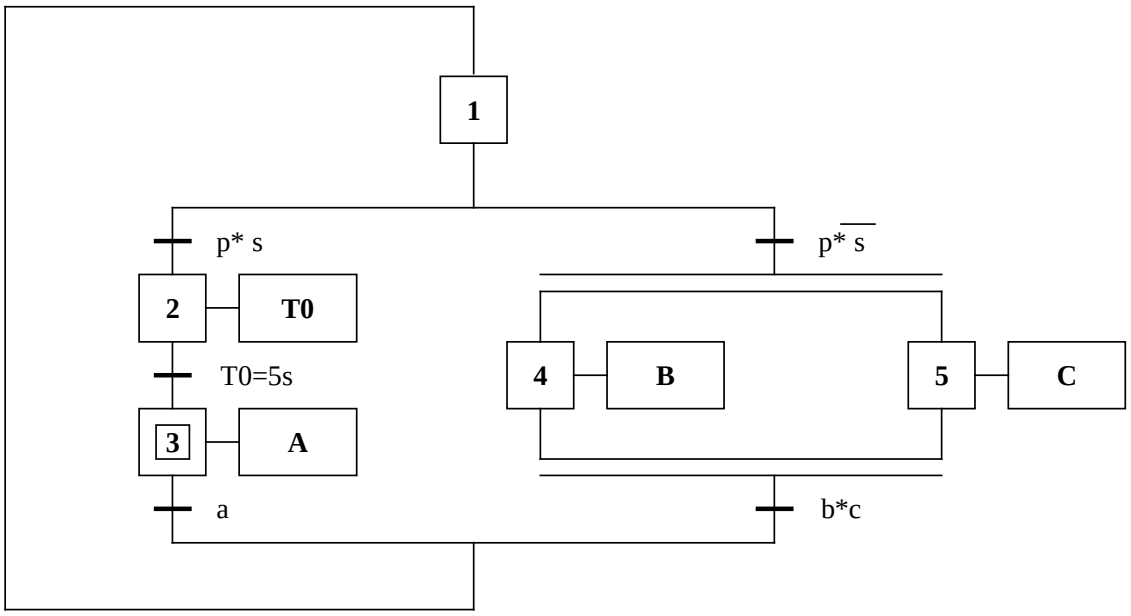
Funcionamento:

- A acção **D** desloca o transportador para a direita e a acção **G** para a esquerda.
- O transportador possui uma pinça para agarrar peças (**AP**), e um sensor que detecta que a peça está segura (**sAP**).
- Os sensores **y** e **z** detectam quando o transportador se encontra sobre os tapetes **A** ou **B**.
- O sensor **x** detecta quando o transportador se encontra sobre o prato.
- Os sensores **a** e **b** detectam a presença de uma peça pronta a ser transportada.
- O sensor **c** detecta uma peça sobre o prato.
- Após o arranque do sistema deve ser garantido o recuo do cilindro **P** e o avanço do cilindro **V**.
- Quando é detectada uma peça pelos sensores **a** ou **b**, o transportador desloca a peça do tapete correspondente para a posição **x** e pousa a peça sobre o prato.
- Seguidamente o cilindro **V** recua e uma vez acabado o seu movimento o cilindro **P** avança e recua deixando a peça no tapete de saída **C**.
- Após o cilindro **P** terminar o seu movimento o cilindro **V** avança.
- As peças do tapete **A** são prioritárias em relação às do tapete **B**.
- Os tapetes **A**, **B** e **C** são controlados por outro sistema.

2. TRADUÇÃO DE GRAFCET PARA LADDER

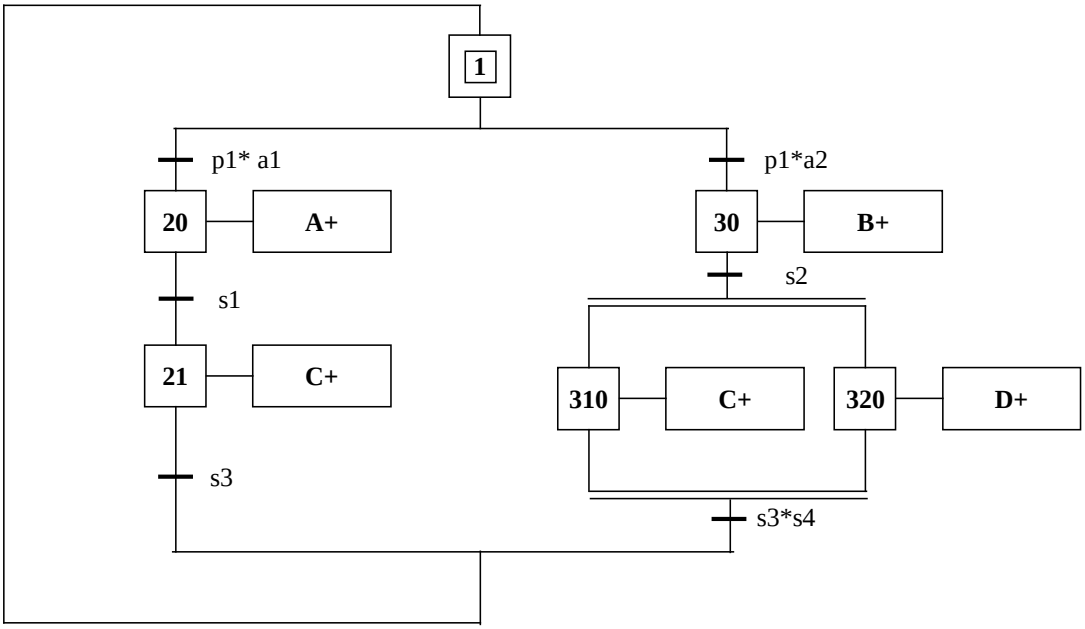
2.1

Traduza o seguinte GRAFCET para Diagrama de Contactos. Apresente todas as equações necessárias para a tradução do GRAFCET.



2.2

Traduza o seguinte GRAFCET para Diagrama de Contactos. Apresente todas as equações necessárias para a tradução do GRAFCET.



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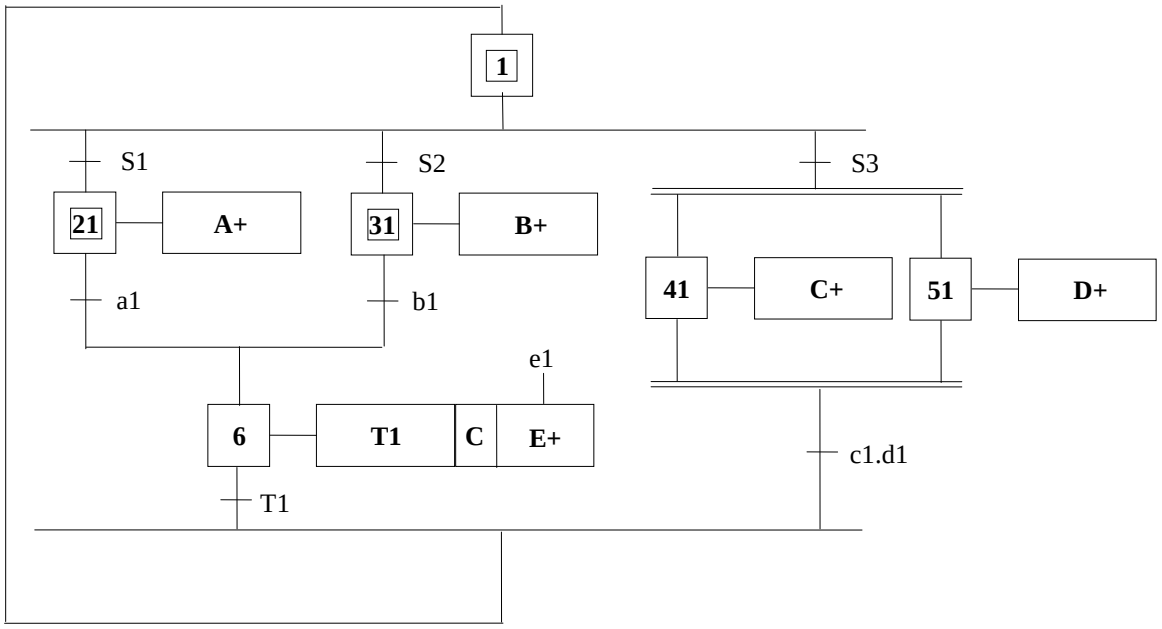
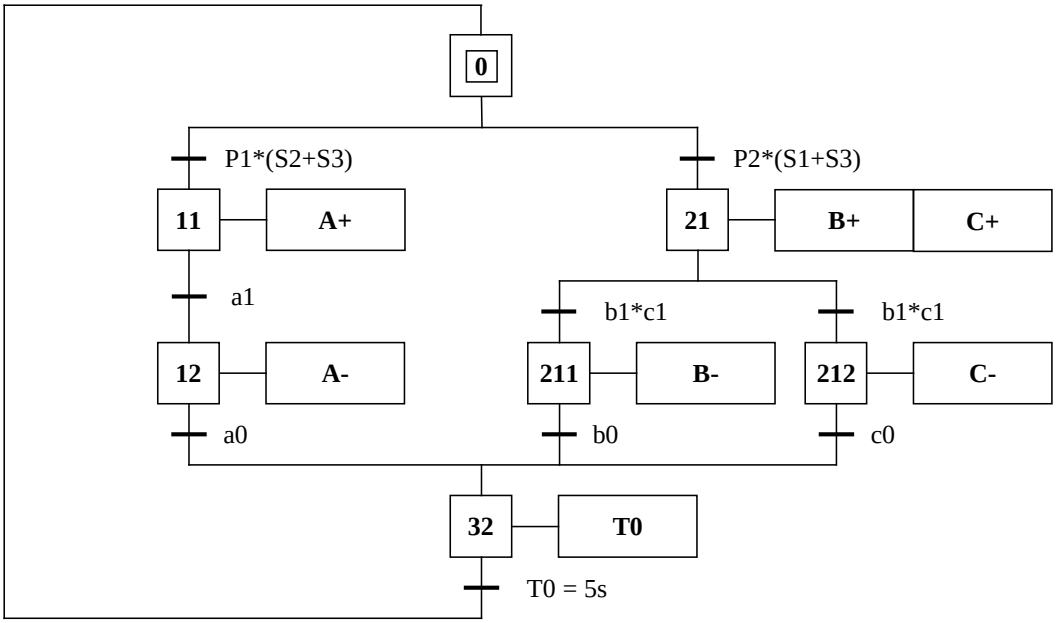


2.4

Traduza o seguinte GRAFCET para Diagrama de Contactos. Apresente todas as equações necessárias para a tradução do GRAFCET.

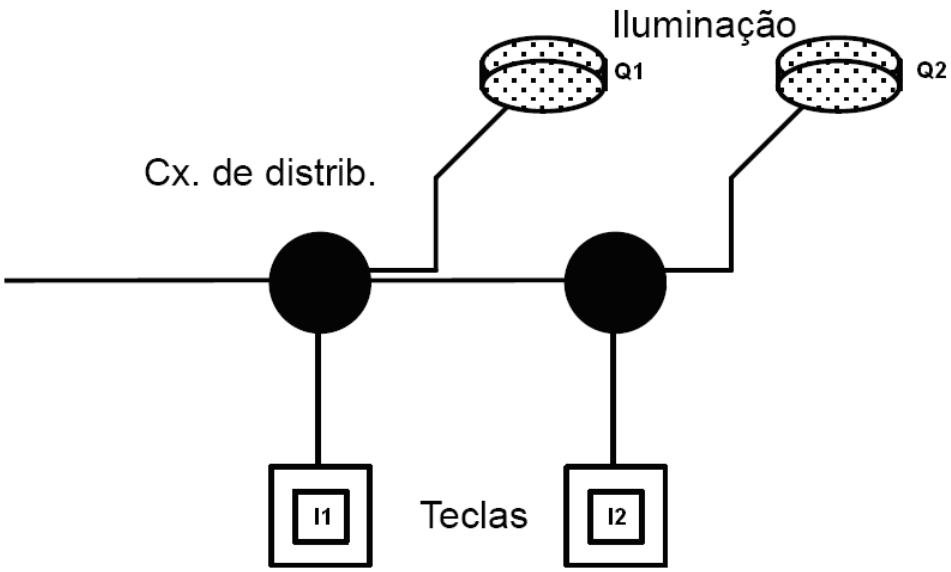


3. MÓDULO LÓGICO LOGO!

3.1

Elabore um programa para o módulo lógico LOGO!, para controlo da iluminação de dois corredores, de acordo com as seguintes condições:

- Pressionar a tecla 1 vez: Acende a luz correspondente durante 1 minuto.
- Pressionar a tecla 2 vezes (no espaço de 1 segundo): Acende a luz correspondente permanentemente.
- Pressionar a tecla durante 2 segundos: Desliga a luz correspondente.

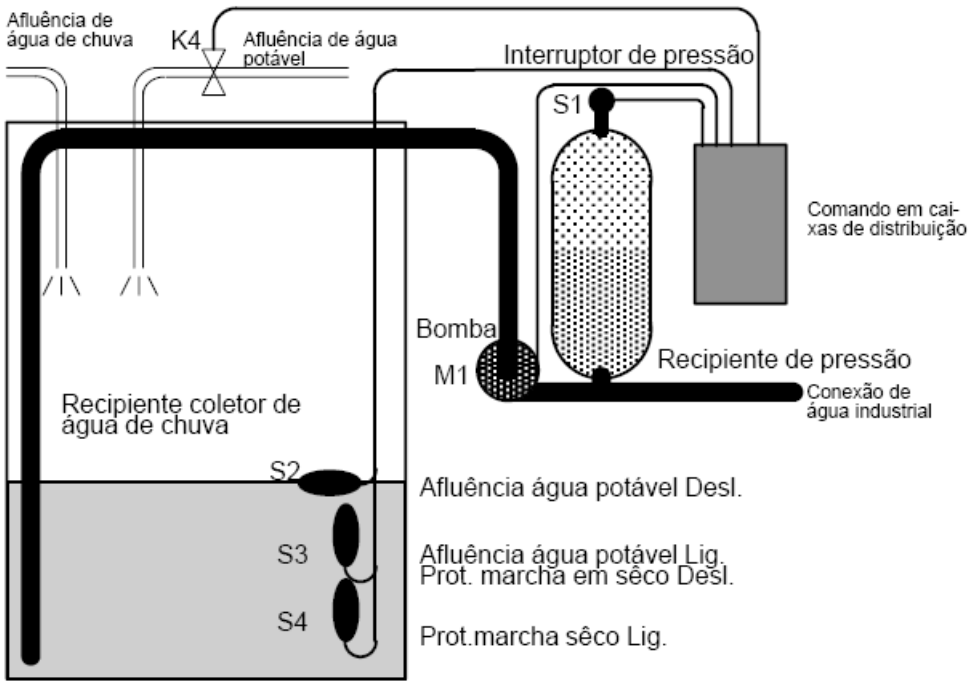


Sinais de controlo:

- **Q1**: Iluminação do corredor 1
- **Q2**: Iluminação do corredor 2
- **I1**: Tecla de comando da iluminação do corredor 1
- **I2**: Tecla de comando da iluminação do corredor 2

3.2

Pretende-se controlar uma instalação industrial para aproveitamento da água da chuva, recorrendo a um módulo lógico LOGO!.
A água da chuva será recolhida num recipiente colector. Do recipiente colector a água da chuva será então bombeada através de uma bomba para a tubagem da rede. A partir de lá a água da chuva poderá ser retirada para uso. Se o recipiente estiver vazio, pode ser introduzida água potável.



Exigências ao funcionamento:

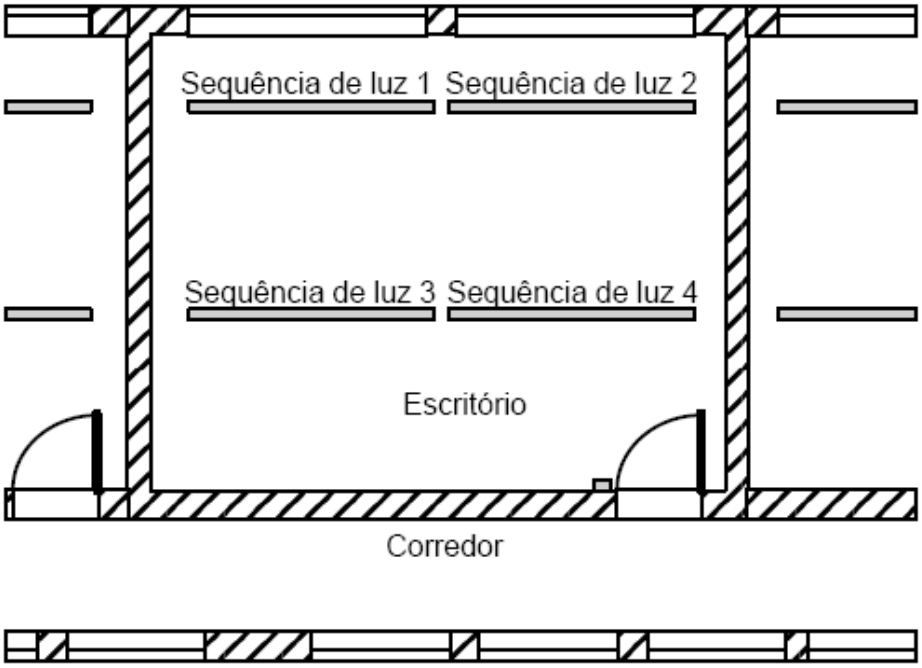
- O interruptor **S1** permite activar e desactivar a bomba **M1** para extracção de água.
- O recipiente deve ser sempre mantido com um nível de água superior a **S3**.
- Caso o nível de água seja inferior a **S3**, este deve ser restabelecido recorrendo a água potável, pela abertura da válvula **K4,** até ser atingido o nível **S2**.
- Caso o nível de água seja inferior a **S4**, deve ser desactivado o sistema de bombagem, para evitar o funcionamento da bomba em seco, sendo este apenas restabelecido quando for atingido o nível **S3**.

Sinais de controlo:

- **Q1**: Bomba **M1**
- **Q2**: Válvula de água potável **K4**
- **I1**: Interruptor **S1**
- **I2**: Sensor de nível **S2**
- **I3**: Sensor de nível **S3**
- **I4**: Sensor de nível **S4**

3.3

Elabore um programa para o módulo lógico LOGO!, para controlo da iluminação de um escritório de acordo com a necessidade de iluminação pretendida. A iluminação está dividida em 4 grupos de iluminação.



Exigências ao funcionamento:

- Havendo bastante luz natural, as sequências de luzes dispostas ao lado da janela serão desligadas automaticamente por um interruptor sensível à luz o que será feito de acordo com o grau de luminosidade existente.
- À noite por volta das 20 horas a luz será desligada automaticamente.
- A iluminação deve poder ser operada manualmente a qualquer hora.

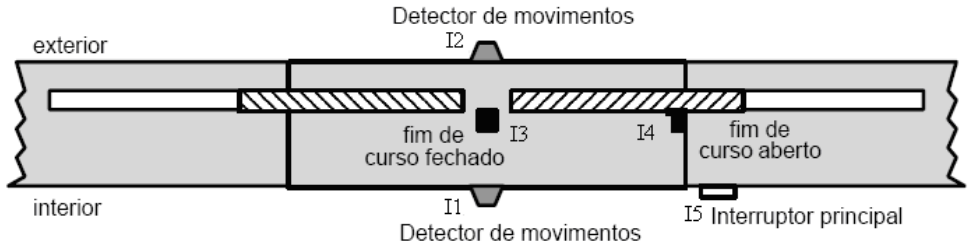
Sinais de controlo:

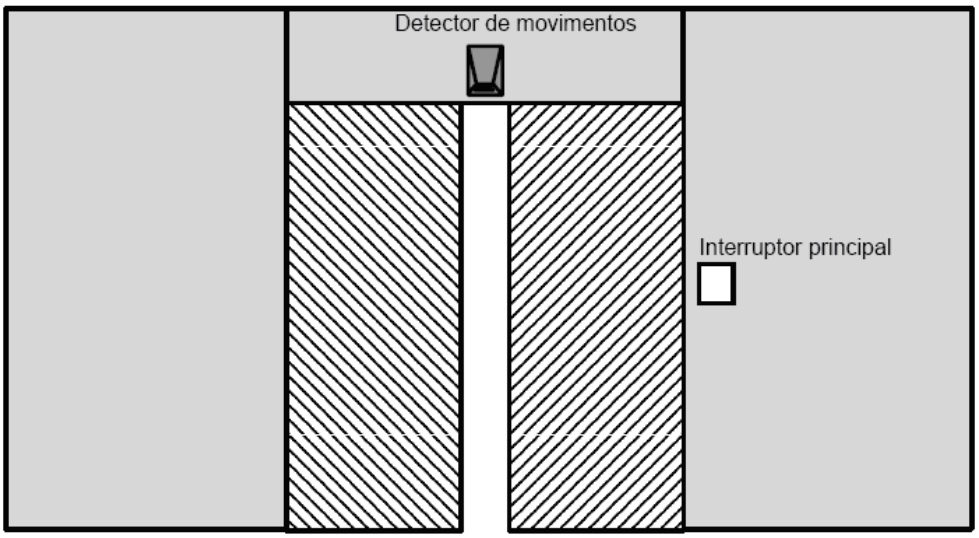
- **Q1** a **Q4**: Comando das sequências de luz
- **I1** a **I4**: Teclas de comando manual
- **I5**: Interruptor fotoeléctrico

3.4

Elabore um programa em diagrama de funções para o módulo lógico LOGO! para controlo de uma porta automática, de acordo com as seguintes condições:

- A porta deve abrir sempre que uma pessoa é detectada pelo detector de movimentos.
- A porta deve permanecer aberta enquanto se encontrar alguém na passagem.
- Se ninguém se encontrar na passagem, a porta deve fechar automaticamente após 5 s.
- O interruptor principal permite bloquear o movimento da porta.





Sinais de controlo:

- **Q1**: Sinal *Abrir Porta*
- **Q2**: Sinal *Fechar Porta*
- **I1**: Detector de movimentos interior
- **I2**: Detector de movimentos exterior
- **I3**: Sensor fim de curso *Porta Fechada*
- **I4**: Sensor fim de curso *Porta Aberta*
- **I5**: Interruptor principal

3.5

Elabore um programa em diagrama de funções para o módulo lógico LOGO! para controlo da iluminação de uma sala em função da entrada e saída de pessoas. A detecção de entrada e saída de pessoas na sala é efectuado por 2 detectores de passagem (**I1** e **I2**) que de acordo com a seguinte sequência:

Sensor	Descrição
$\overline{I_1} \rightarrow \overline{I_2}$	Detecção de entrada de pessoas na sala
$\overline{I_2} \rightarrow \overline{I_1}$	Detecção de saída de pessoas na sala

O sistema deve controlar a iluminação de acordo com as seguintes condições:

Saída	Descrição	Condição
Q1	Iluminação da sala	Mais do que uma pessoa na sala
Q2	Sinal de proibição de entrada	Sala cheia: 10 pessoas na sala
Q3	Iluminação do corredor de entrada	Pessoa a entrar. Acende 10 segundos
Q4	Iluminação do corredor de saída	Pessoa a sair: Acende 10 segundos

O sistema deve ainda contemplar um interruptor de pressão (**I3**) que permita repor os contadores a zero.

3.6

Elabore um programa em diagrama de funções para o módulo lógico LOGO! para controlo de um sequenciador de 3 leds (**Q1**, **Q2** e **Q3**). Cada led deve permanecer aceso durante **1 segundo**, sendo a sequência controlada de acordo com as seguintes condições impostas pelas duas entradas de contolo (**I1** e **I2**):

I2	I1	Sequência
0	x	Parado
1	0	Sequência Q1, Q2, Q3
	1	Sequência Q3, Q2, Q1

4. AUTÓMATO PROGRAMÁVEL TWIDO

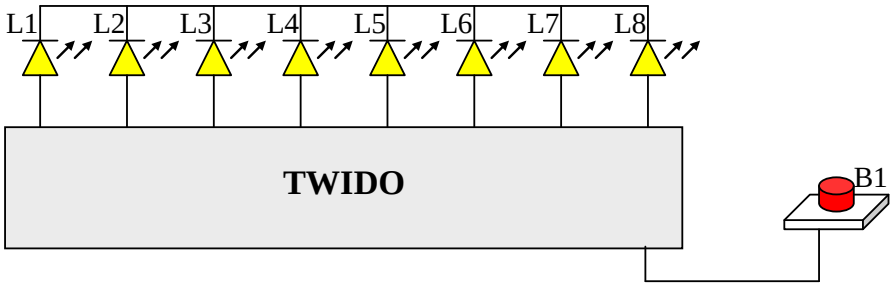
4.1

Pretende-se controlar a saída de água quente de 3 chuveiros num parque de campismo. Cada chuveiro funciona separadamente. O utilizador ao procurar uma das cabinas com a luz verde acesa, introduz uma ficha na máquina (**s**), actuando a abertura de uma válvula de água quente (**V**). A válvula deve permanecer aberta durante 5 minutos, durante os quais deve permanecer acesa a luz vermelha (**LE**) em vez da verde (**LV**).
Para controlo do sistema utiliza-se um autómato TWIDO. Para tal, faça uma atribuição das E/S do autómato aos sinais de controlo e comando e elabore o respectivo programa.

4.2

Elabore um programa para o autómato TWIDO que simule um sequenciador de 8 leds (**L1** a **L8**). Os leds devem acender e apagar de forma sequencial e cíclica, com intervalos de 1 segundo, sendo o sentido da rotação controlado por um botão **B1**:

- **B1** = 0 – Rotação para a direita
- **B1** = 1 – Rotação para a esquerda



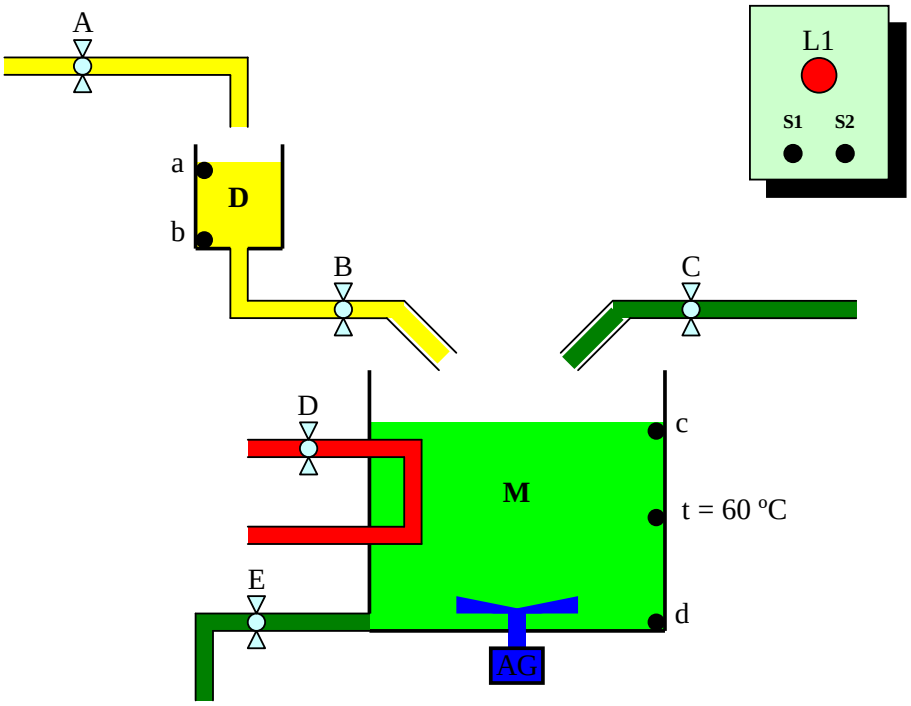
4.3

Elabore um programa para o autómato TWIDO para controlo da iluminação de uma sala com 3 luminárias (**L1**, **L2** e **L3**). Estas são comandadas por dois botões de pressão. O botão 1 (**b1**) permite alternar entre os vários estados de iluminação. O botão 2 (**b2**) permite desligar todas as luminárias, 5 segundos após este ser premido. Os estados de iluminação são:

Estado	L1	L2	L3
1	OFF	OFF	OFF
2	ON	OFF	OFF
3	OFF	ON	OFF
4	OFF	OFF	ON
5	ON	ON	OFF
6	OFF	ON	ON
7	ON	ON	ON

4.4

Elabore um programa para o autómato TWIDO para controlo de um sistema de mistura e dosagem de produtos líquidos.

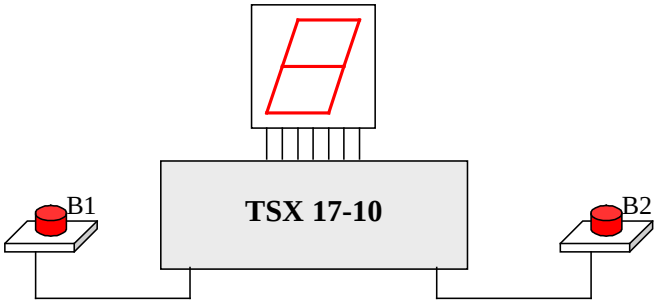


Funcionamento do sistema:

- Após ser premido o botão de START (**S1**) o sistema entra em funcionamento, executando o processo ciclicamente até ser pressionado o botão de STOP (**S2**). Durante o processo de funcionamento deve permanecer aceso o sinalizador **L1**.
- O processo é iniciado com a aberta da electroválvula **A** para enchimento do reservatório **D**, até ser atingido o nível de dosagem pretendida, indicado pelo sensor **a**.
- Seguidamente é fechada a electroválvula **A** aberta a electroválvula **B** para despejo do reservatório **M** e a electroválvula **C**, para enchimento do reservatório de mistura **M**.
- A electroválvula **B** deve ser fechada quando o reservatório **D** estiver vazio, indicado pelo sensor **b** e a electroválvula **C** deve ser fechada quando o reservatório **M** se encontrar cheio, indicado pelo sensor c.
- Em seguida deve ser ligado o agitador **AG** e aberta a electroválvula **D**, para mistura e aquecimento dos líquidos.
- A acção deve decorrer até que seja atingida uma temperatura de 60º C dentro do tanque **M**. A temperatura é detectada pelo sensor **t**.
- O sistema deve em seguida parar o agitador **AG**, fechar a electroválvula **D** e abrir a electroválvula **E** para despejo do tanque **M**.
- O processo encontra-se concluído quando o sensor **d** detectar o tanque vazio.

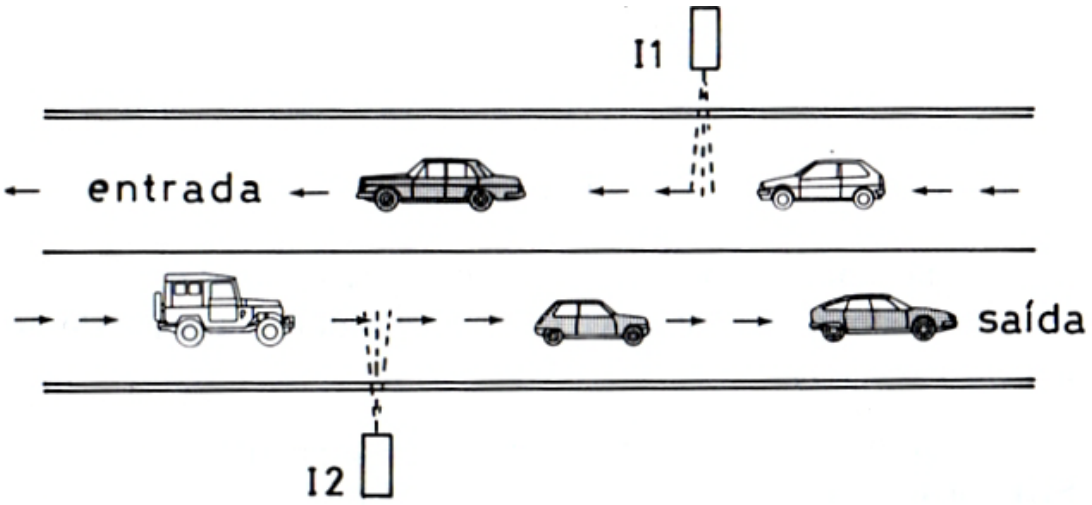
4.5

Elabore um programa em para o autómato TWIDO que efectue a contagem do número de vezes que um botão (**B1**) é premido (0 a 9). A contagem deve ser visualizada num display de 7 segmentos. A contagem seguinte a 9 será 1. Deve ser implementado um botão de reinício de contagem (**B2**).



4.6

Implemente um programa para o autómato TWIDO para controlo de acessos de um parque de estacionamento com capacidade para 50 automóveis. O parque possui uma via para a entrada de veículos e outra para a saída.

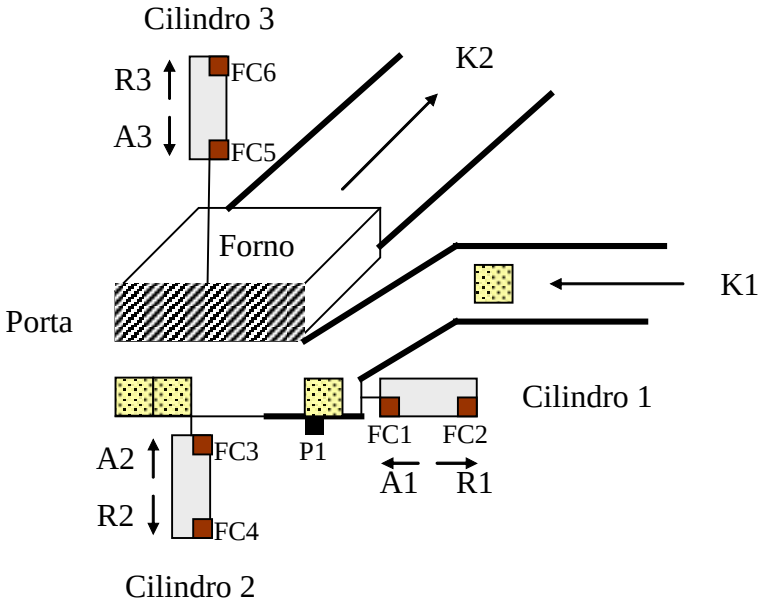


Funcionamento:

- A entrada e saída de viaturas são assinaladas pelos sensores **I1** e **I2**.
- O parque possui dois sinalizadores luminosos, um verde (**SV**) e outro encarnado (**SE**), que indicam se o parque está livre ou esgotado.
- O botão de Reset (**R**) permite fazer uma inicialização ao sistema, colocando o nº de viaturas presentes a zero.

4.7

Pretende-se controlar um mecanismo de carregamento de um forno com cubos através de um autómato TWIDO. Para tal, desenvolva um programa de acordo com o seguinte funcionamento:

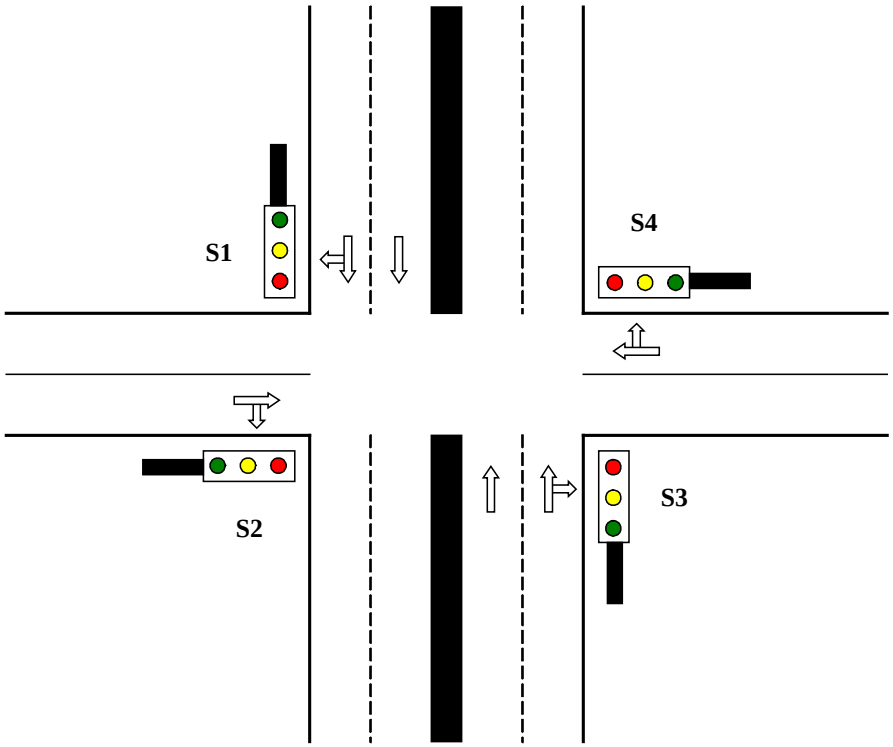


- O processo é iniciado automaticamente após a activação do autómato e funciona de forma cíclica.
- No início do processo devem ser garantidas as seguintes posições dos cilindros: cilindro 1: FC2; cilindro 2: FC4; cilindro 3: FC5.
- Seguidamente os tapetes K1 e K2 são colocados em movimento.
- Quando é detectado um cubo pelo detector P1 é efectuado o movimento A1 no cilindro 1, até o cilindro chegar ao seu fim de curso FC1, devendo ser efectuado o movimento R1 até ao sensor fim de curso FC2.
- Após a colocação de 4 cubos em frente ao forno, deve ser aberta a porta do forno, através do movimento R3 no cilindro 3, até ao sensor FC6 e o cilindro 2 deve colocar os cubos dentro do forno através do movimento A2, até ao sensor FC3.
- O sensor FC3 detecta a finalização da tarefa de carregamento do forno, permitindo o recuo do cilindro 2, através do movimento R2, até ao sensor FC4 e o fecho da porta do forno através do movimento A3 até ao sensor FC5.
- Durante a tarefa de carregamento do forno e de recuo do cilindro 2 deve ser inibido funcionamento do tapete K1.

4.8

Escreva um programa para o autómato TWIDO para controlo dos semáforos do cruzamento representado na figura.
O automatismo deve dispor de um interruptor bi-estável que define o modo de funcionamento: normal ou todos os semáforos em amarelo intermitente.
Devem ser respeitadas as seguintes temporizações:

- **Sinal Vermelho**: 30 segundos
- **Sinal Verde**: 15 segundos
- **Sinal amarelo**: 5 segundos
- **Amarelo intermitente**: 2 segundo



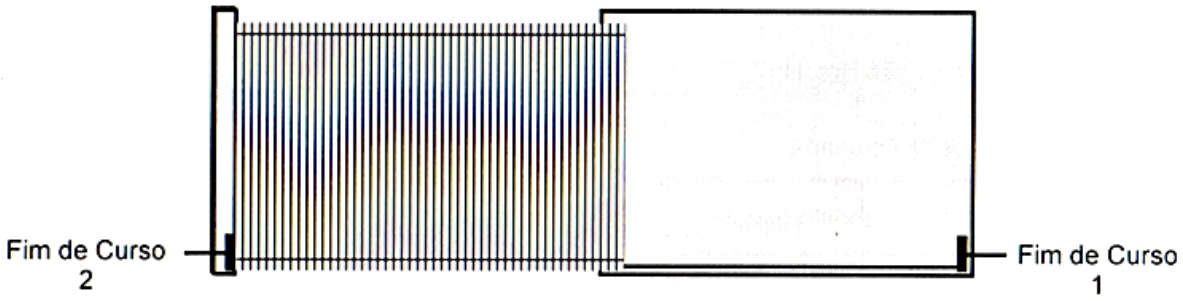
Nota: Após um semáforo comutar para vermelho, o semáforo da rua perpendicular só deve comutar para verde passados 5 segundos.

Sinais do sistema:

• **I**: Interruptor de controlo do modo de funcionamento	
• **S1E**: Sinal vermelho do semáforo 1	• **S3E**: Sinal vermelho do semáforo 3
• **S1A**: Sinal amarelo do semáforo 1	• **S3A**: Sinal amarelo do semáforo 3
• **S1V**: Sinal verde do semáforo 1	• **S3V**: Sinal verde do semáforo 3
• **S2E**: Sinal vermelho do semáforo 2	• **S4E**: Sinal vermelho do semáforo 4
• **S2A**: Sinal amarelo do semáforo 2	• **S4A**: Sinal amarelo do semáforo 4
• **S2V**: Sinal verde do semáforo 2	• **S4V**: Sinal verde do semáforo 4

4.9

Elabore um programa para o autómato TWIDO para controlo de um portão. Por intermédio de uma única botoneira podem-se realizar a abertura e o fecho total do portão, além de interromper estes movimentos em qualquer instante.

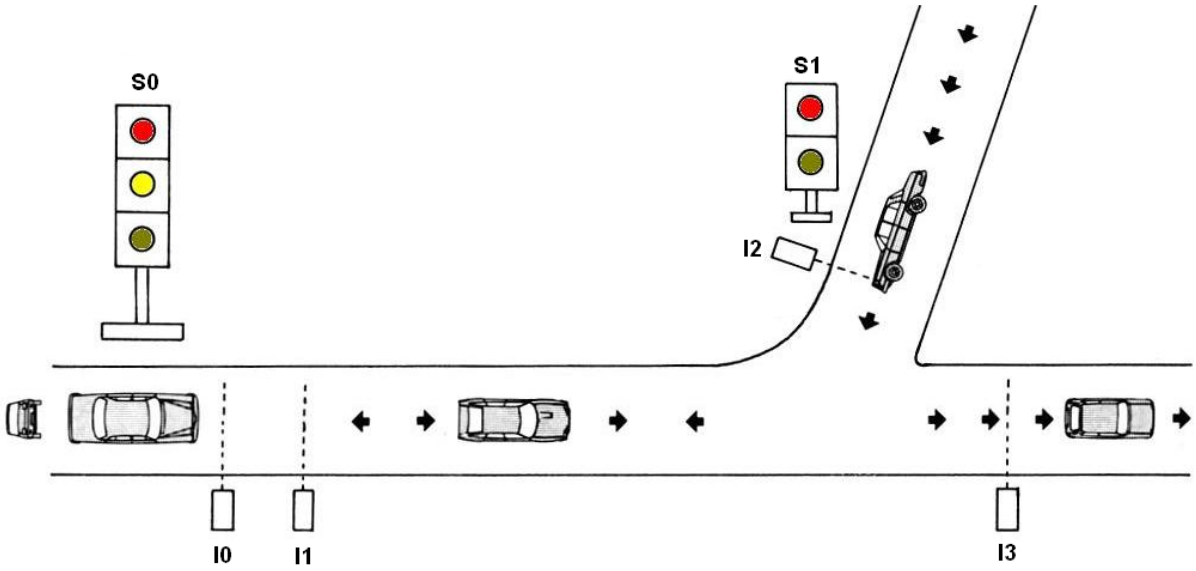


Funcionamento:

- No primeiro accionamento da botoneira, inicia-se a abertura do portão.
- Este movimento finaliza quando o portão estiver totalmente aberto, sendo este estado sinalizado pelo sensor Fim de Curso 1.
- Com o portão totalmente aberto o accionamento da botoneira permite fechar o portão.
- Este movimento finaliza quando o portão estiver totalmente fechado, sendo este estado sinalizado pelo sensor Fim de Curso 2.
- Durante o movimento de abertura do portão, se a botoneira for novamente accionada, o movimento deve ser interrompido. Um novo accionamento da botoneira permite fechar o portão.
- Durante o movimento de fecho do portão, se a botoneira for novamente accionada, o movimento deve ser interrompido e iniciado o movimento de abertura do portão.

4.10

Implemente um programa para o autómato TWIDO para controlo de acessos de um parque de estacionamento com capacidade para 50 automóveis. O parque possui uma única via para a entrada e saída de veículos.



Os sensores I0, I1, I2 e I3 permitem detectar a entrada e saída de viaturas, da seguinte forma:

Sensor	Descrição
I0 → I1	Detectam que existe uma viatura na via de acesso para entrar no parque
I1 → I0	Detectam que uma viatura saiu do parque
I2	Detectam que existe uma viatura na via de acesso para sair do parque
I3	Detectam que uma viatura entrou no parque

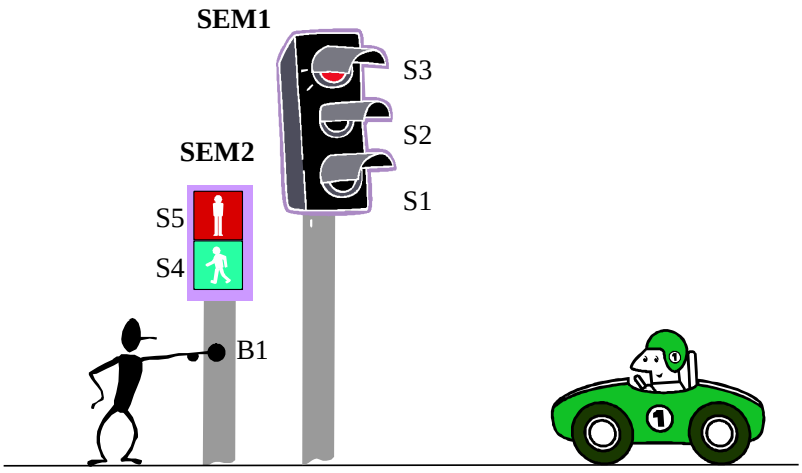
Os semáforos S0 e S1 devem ser controlados de modo a sinalizar a seguinte informação:

Sem.	Luz	Descrição
S0	Verde	Sinaliza que o parque está livre
	Amarelo	Sinaliza que existe uma viatura na via de acesso a sair do parque
	Vermelho	Sinaliza que o parque está ocupado
S1	Verde	Sinaliza que a viatura pode sair
	Vermelho	Sinaliza que existe uma viatura na via de acesso a entrar do parque

4.11

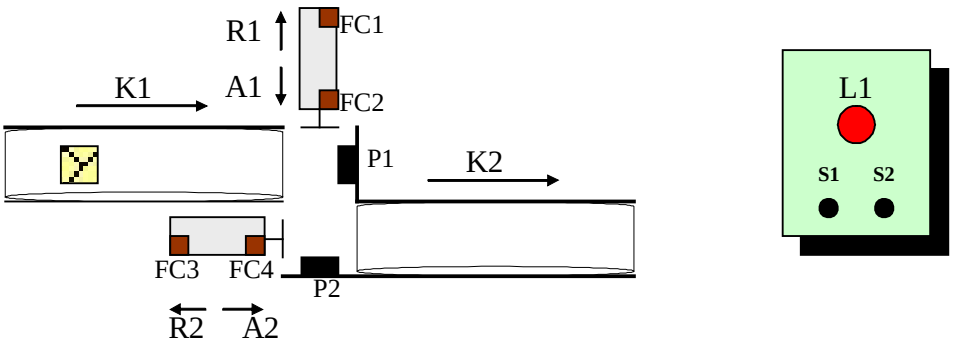
Elabore um programa para o autómato TWIDO para controlo de uma passagem de peões. O sistema é composto por um semáforo para peões (**SEM2**) e um semáforo de trânsito (**SEM1**). O controlo dos semáforos é efectuado através de um botão de passagem de peões (**B1**). Funcionamento:

- Inicialmente o semáforo **SEM1** mantém a luz verde acesa (**S1**) e o semáforo **SEM2** a luz vermelha acesa (**S5**).
- Sendo efectuado um pedido de passagem de peão (**B1**), o semáforo **SEM1** comuta para a luz amarela (**S2**), permanecendo neste estado durante 5 segundos.
- Decorrido o tempo estabelecido, o semáforo **SEM1** comuta para a luz vermelha **S3** e o semáforo **SEM2** para a luz verde (**S4**). O sistema deverá permanecer neste estado durante 20 segundos, após o qual o ciclo é reiniciado.



4.12

Elabore um programa para o autómato TWIDO para controlo de uma linha de transporte composta por 2 tapetes e 2 cilindros pneumáticos de efeito duplo.



O processo é iniciado pelo botão de START (**S1**) e finalizado pelo botão de STOP (**S2**), sendo o funcionamento contínuo e sinalizado pelo led **L1**.
Durante o funcionamento os tapetes devem permanecer sempre activos, comandados pelos relés **K1** e **K2**. Os cilindros devem actuar de acordo com o estado dos sensores:

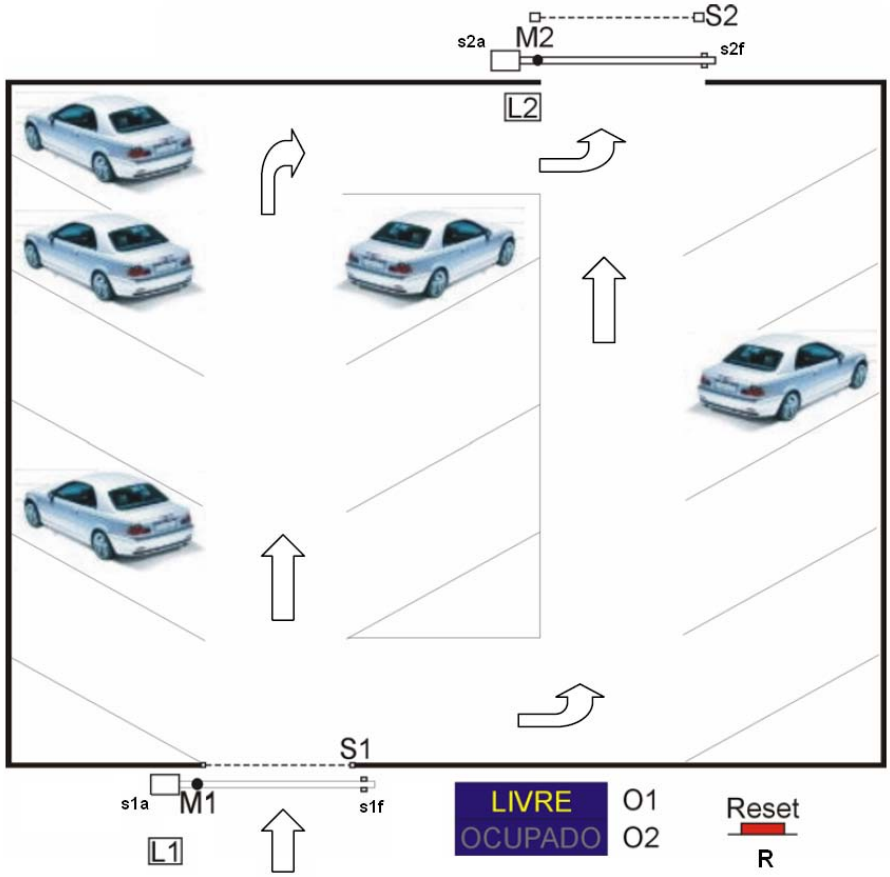
- A Detecção de uma peça pelo sensor **P1** provoca o movimento **A1** até ao fim de curso **FC2**.
- A Detecção de uma peça pelo sensor **P2** provoca o movimento **A2** até ao fim de curso **FC4**.
- A detecção de **FC2** provoca o movimento **R1** até detecção de **FC1**.
- A detecção de **FC4** provoca o movimento **R2** até detecção de **FC3**.

4.13

Considere uma hipotética máquina automática de venda de bebidas quentes, nomeadamente café e chocolate.
Existem duas ranhuras para moedas e é através da introdução de uma moeda na ranhura apropriada que se escolhe a bebida pretendida, uma **m_cafe** para um café e uma **m_choc** para um chocolate. Após a introdução da moeda, é necessário ligar o motor que deposita um COPO até que o sensor de **copo_presente** indique que essa operação está completa. Seguidamente é necessário abrir a válvula do **CAFÉ** ou **CHOCOLATE** durante 5 segundos, enchendo assim o copo.
O copo está protegido por uma porta e utiliza-se um **TRINCO** (actuador impulsional) para abrir a porta. Para assinalar este facto faz-se piscar uma **LUZ**, que alterna um segundo ligado e outro segundo desligado.
O processo encerra quando o copo desaparece mas a máquina só poderá ser utilizada 10 segundos depois dessa ocorrência.
Para manter as bebidas quentes existem dois sensores **chocolate_frio** e **café_frio** que assinalam a necessidade de ligar durante um minuto o sistema **AQUECE_CHOC** e **AQUECE_CAFÉ**, respectivamente.
Elabore um programa para o autómato TWIDO para controlo do funcionamento desta máquina.

4.14

Considere um parque de estacionamento com capacidade para 13 viaturas, cujo controlo de entrada e de saída é realizado por meio de cartões magnéticos.



Funcionamento:

- A entrada e saída de viaturas são assinaladas pelos leitores de cartões magnéticos **L1** e **L2**, permitindo aos motores **M1** e **M2** levantar as cancelas.
- Os fins de curso das cancelas são assinalados pelos sensores **s1a**, **s1f**, **s2a** e **s2f**.
- A cancela só deve baixar após a viatura passar pelas células fotoeléctricas **S1** e **S2** e estas deixarem de ser accionadas.
- A cancela de entrada só deve abrir se houver lugar no parque.
- O letreiro "LIVRE" (**O1**) estará aceso sempre que houver lugar no parque, caso contrário acenderá o letreiro "OCUPADO" (**O2**).
- O botão de Reset (**R**) permite fazer uma inicialização ao sistema, colocando o nº de viaturas presentes a zero.

Implemente um programa para o autómato TWIDO, que permita fazer o controlo do parque de estacionamento.

ANEXOS

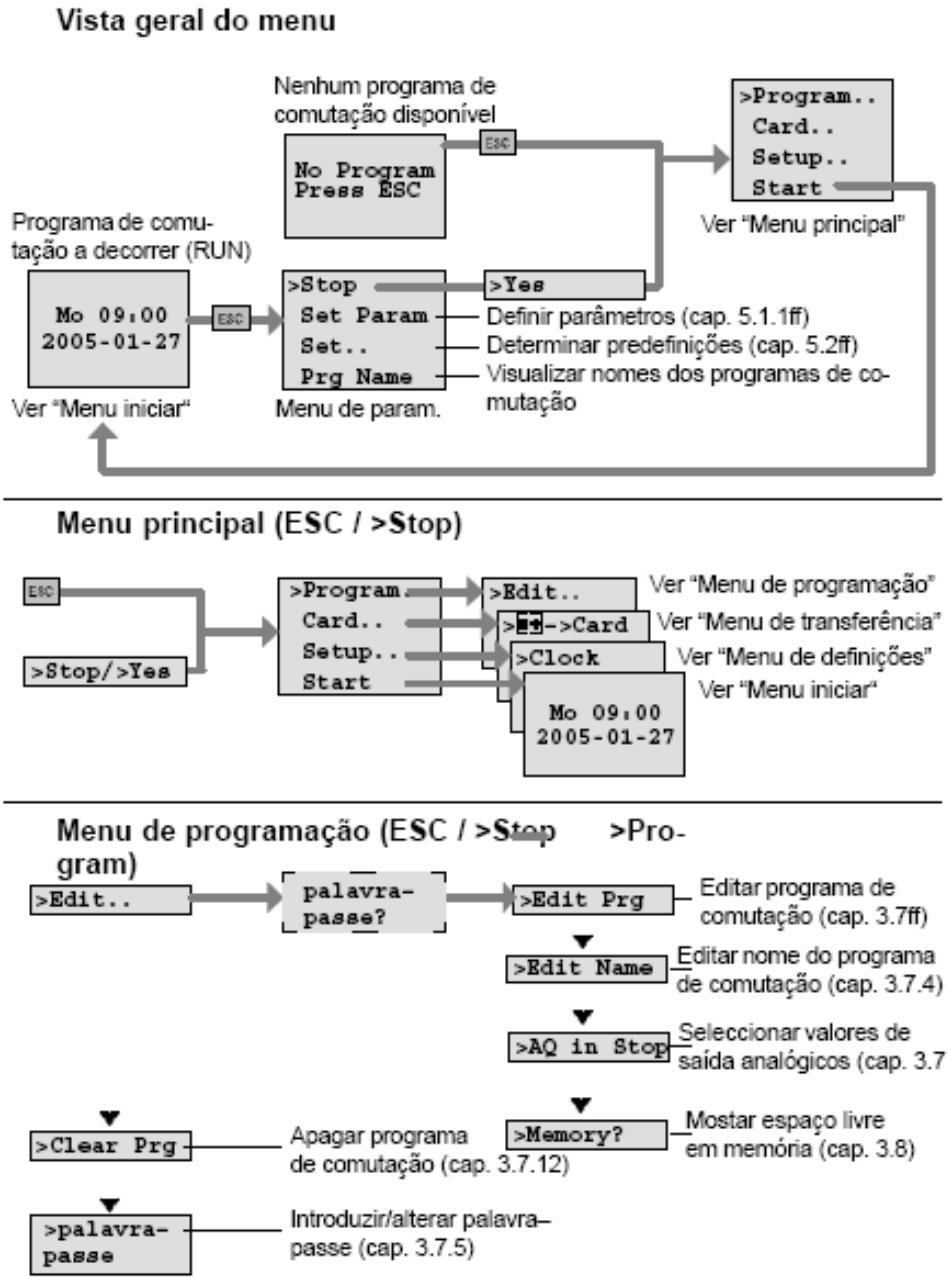
1. LOGO!

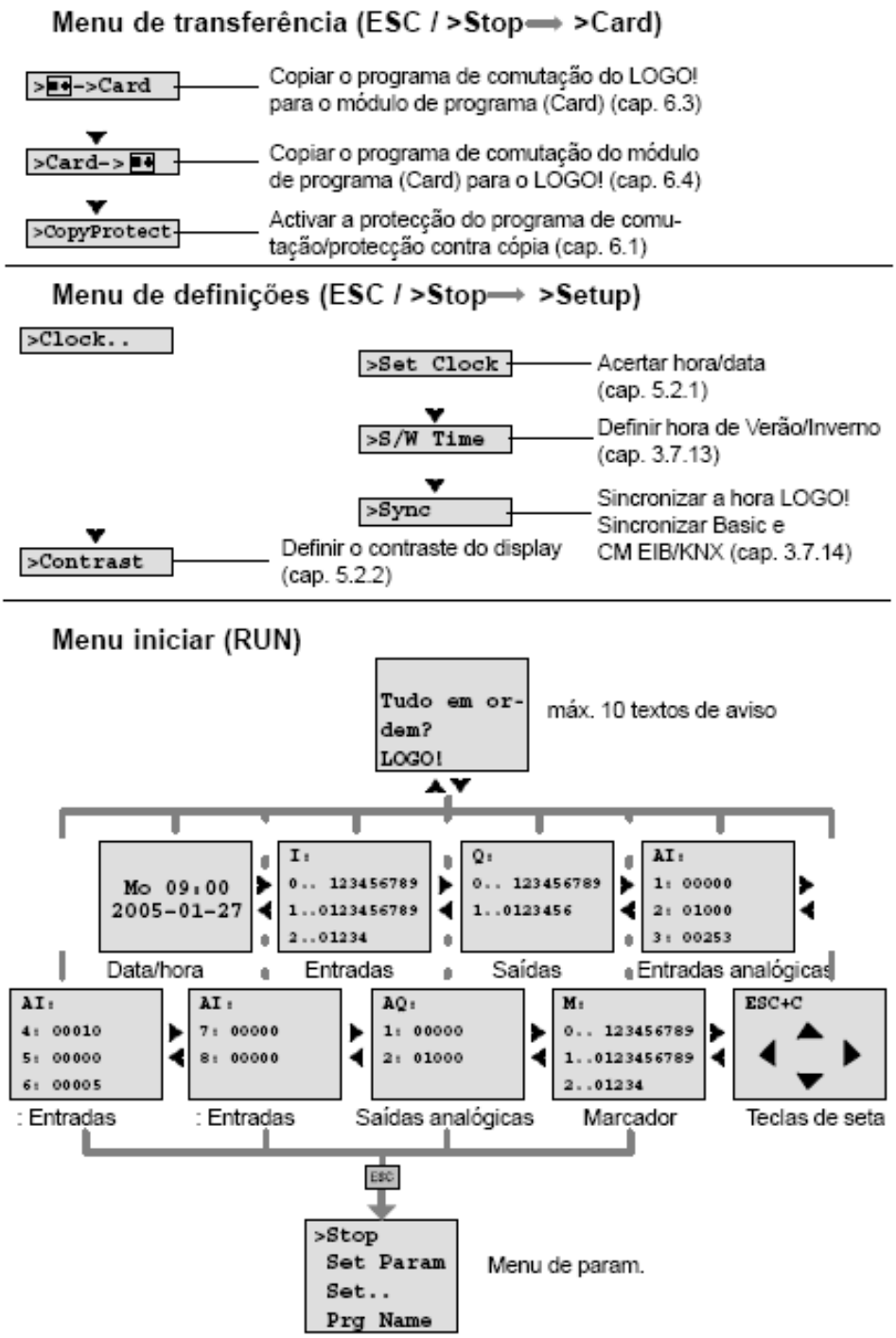
1.1. MODELOS DISPONÍVEIS

Variante	Designação	Número de encomenda
Basic	LOGO! 12/24RC *	6ED1052-1MD00-0BA5
	LOGO! 24 *	6ED1052-1CC00-0BA5
	LOGO! 24RC (AC)	6ED1052-1HB00-0BA5
	LOGO! 230RC	6ED1052-1FB00-0BA5
Basic sem display (Pure)	LOGO! 12/24RCo *	6ED1052-2MD00-0BA5
	LOGO! 24o *	6ED1052-2CC00-0BA5
	LOGO! 24RCo (AC)	6ED1052-2HB00-0BA5
	LOGO! 230RCo	6ED1052-2FB00-0BA5
Módulos digitais	LOGO! DM 8 12/24R	6ED1055-1MB00-0BA1
	LOGO! DM 8 24	6ED1055-1CB00-0BA0
	LOGO! DM 8 24R	6ED1055-1HB00-0BA0
	LOGO! DM 8 230R	6ED1055-1FB00-0BA1
	LOGO! DM 16 24	6ED1055-1CB10-0BA0
	LOGO! DM 16 24R	6ED1055-1NB10-0BA0
	LOGO! DM 16 230R	6ED1055-1FB10-0BA0
Módulos analógicos	LOGO! AM 2	6ED1055-1MA00-0BA0
	LOGO! AM 2 PT100	6ED1055-1MD00-0BA0
	LOGO! AM 2 AQ	6ED1055-1MM00-0BA0
Módulos decomunicação	CM EIB/KNX	6BK1700-0BA00-0AA1
	CM Interface AS	3RK1400-0CE10-0AA2

*: suplementarmente com entradas analógicas

1.2. ESTRUTURA DOS MENUS




Menu de transferência (ESC / >Stop ⟹ >Card)
>■◆->Card
Copiar o programa de comutação do LOGO! para o módulo de programa (Card) (cap. 6.3)
>Card->■◆
Copiar o programa de comutação do módulo de programa (Card) para o LOGO! (cap. 6.4)
>CopyProtect
Activar a protecção do programa de comutação/protecção contra cópia (cap. 6.1)
Menu de definições (ESC / >Stop ⟹ >Setup)
>Clock..
>Set Clock
Acertar hora/data (cap. 5.2.1)
>S/W Time
Definir hora de Verão/Inverno (cap. 3.7.13)
>Sync
Sincronizar a hora LOGO! Sincronizar Basic e CM EIB/KNX (cap. 3.7.14)
>Contrast
Definir o contraste do display (cap. 5.2.2)
Menu iniciar (RUN)
Tudo em ordem? LOGO!
máx. 10 textos de aviso
Mo 09:00 2005-01-27
Data/hora
I: 0.. 123456789 1..0123456789 2..01234
Entradas
Q: 0.. 123456789 1..0123456
Saídas
AI: 1: 00000 2: 01000 3: 00253
Entradas analógicas
AI: 4: 00010 5: 00000 6: 00005
: Entradas
AI: 7: 00000 8: 00000
: Entradas
AQ: 1: 00000 2: 01000
Saídas analógicas
M: 0.. 123456789 1..0123456789 2..01234
Marcador
ESC+C
Teclas de seta
ESC
>Stop Set Param Set.. Prg Name
Menu de param.

2. TWIDO

2.1. MODELOS DISPONÍVEIS

Controller Name	Reference	Chan-nels	Channel type	Input/Output type	Power supply
Compact 10 I/O	TWDLCAA10DRF	6	Inputs	24 VDC	100/240 VAC
		4	Outputs	Relay	
Compact 10 I/O	TWDLCDA10DRF	6	Inputs	24 VDC	24 VDC
		4	Outputs	Relay	
Compact 16 I/O	TWDLCAA16DRF	9	Inputs	24 VDC	100/240 VAC
		7	Outputs	Relay	
Compact 16 I/O	TWDLCDA16DRF	9	Inputs	24 VDC	24 VDC
		7	Outputs	Relay	
Compact 24 I/O	TWDLCAA24DRF	14	Inputs	24 VDC	100/240 VAC
		10	Outputs	Relay	
Compact 24 I/O	TWDLCDA24DRF	14	Inputs	24 VDC	24 VDC
		10	Outputs	Relay	
Compact 40 I/O	TWDLCAA40DRF TWDLCAE40DRF	24	Inputs	24 VDC	100/240 VAC
		16	Outputs	Relay X 14 Transistors X 2	
Modular 20 I/O	TWDLMDA20DUK	12	Inputs	24 VDC	24 VDC
		8	Outputs	Transistor sink	
Modular 20 I/O	TWDLMDA20DTK	12	Inputs	24 VDC	24 VDC
		8	Outputs	Transistor source	
Modular 20 I/O	TWDLMDA20DRT	12	Inputs	24 VDC	24 VDC
		6 2	Outputs Outputs	Relay Transistor source	
Modular 40 I/O	TWDLMDA40DUK	24	Inputs	24 VDC	24 VDC
		16	Outputs	Transistor sink	
Modular 40 I/O	TWDLMDA40DTK	24	Inputs	24 VDC	24 VDC
		16	Outputs	Transistor source	

2.2. MÓDULOS DE EXPANSÃO DISPONÍVEIS

2.2.1. MÓDULOS DIGITAIS DE E/S

Module Name	Reference	Chan-nels	Channel type	Input/Output type	Terminal type
Input modules					
8-point input	TWDDDI8DT	8	Inputs	24 VDC	Removable terminal block
8-point input	TWDDAI8DT	8	Inputs	120 VAC	Removable terminal block
16-point input	TWDDDI16DT	16	Inputs	24 VDC	Removable terminal block
16-point input	TWDDDI16DK	16	Inputs	24 VDC	Connector
32-point input	TWDDDI32DK	32	Inputs	24 VDC	Connector
Output Modules					
8-point output	TWDDD08UT	8	Outputs	Transistor sink	Removable terminal block
8-point output	TWDDD08TT	8	Outputs	Transistor source	Removable terminal block
8-point output	TWDDRA8RT	8	Outputs	Relay	Removable terminal block
16-point output	TWDDRA16RT	16	Outputs	Relay	Removable terminal block
16-point output	TWDDDO16UK	16	Outputs	Transistor sink	Connector
16-point output	TWDDDO16TK	16	Outputs	Transistor source	Connector
32-point output	TWDDDO32UK	32	Outputs	Transistor sink	Connector
32-point output	TWDDDO32TK	32	Outputs	Transistor source	Connector
Mixed modules					
4-point input/4-point output	TWDDMM8DRT	4	Inputs	24 VDC	Removable terminal block
		4	Outputs	Relay	
16-point input/ 8-point output	TWDDMM24DRF	16	Inputs	24 VDC	Non-removable terminal block
		8	Outputs	Relay	

2.2.2. MÓDULOS ANALÓGICOS DE E/S

Module name	Reference	Channel	Channel type	Details	Terminal type
2 high level inputs	TWDAMI2HT	2	Inputs	12 bits 0-10 V, 4-20 mA	Removable terminal block
1 high level output	TWDAM01HT	1	Outputs	12 bits 0-10 V, 4-20 mA	Removable terminal block
2 high level inputs/1 output	TWDAMM3HT	2 1	Inputs Outputs	12 bits 0-10 V, 4-20 mA	Removable terminal block
2 low level inputs/1 high level output	TWDALM3LT	2 1	Inputs Outputs	12 bits 0-10V, 4-20mA, RTD, thermocouple	Removable terminal block

2.2.3. MÓDULO AS-INTERFACE V2 BUS MASTER

Module name	Reference	Number of slaves	Maximum number of channels	Power supply	Terminal type
AS-Interface master	TWDNOI10M3	Maximum 62	248 inputs 186 outputs	30 VDC	Removable terminal block

2.3. MÁXIMAS CONFIGURAÇÕES DE HARDWARE

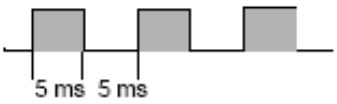
2.3.1. AUTÓMATOS COMPACTOS

Controller Item	Compact controller			
TWD...	LCAA10DRF LCDA10DRF	LCAA16DRF LCDA16DRF	LCAA24DRF LCDA24DRF	LCAA40DRF LCAE40DRF
Standard digital inputs	6	9	14	24
Standard digital outputs	4	7	10	16 (14 Relay +2 Transistor outputs)
Max expansion I/O modules (Digital or analog)	0	0	4	7
Max digital inputs (controller I/O + exp I/O)	6	9	14+(4x32)=142	24+(7x32)=248
Max digital outputs (controller I/O + exp I/O)	4	7	10+(4x32)=138	16+(7x32)=240
Max digital I/O (controller I/O + exp I/O)	10	16	24+(4x32)=152	40+(7x32)=264
Max AS-Interface bus interface modules	0	0	2	2
Max I/O with AS-Interface modules (7 I/O per slave)	10	16	24+(2x62x7) =892	40+(2x62x7) =908
Max relay outputs	4 base only	7 base only	10 base + 32 expansion	14 base + 96 expansion
Potentiometers	1	1	2	2
Built-in analog inputs	0	0	0	0
Max analog I/O (controller I/O + exp I/O)	0 in / 0 out	0 in / 0 out	8 in / 4 out	15 in / 7 out
Remote controllers	7	7	7	7
Serial ports	1	2	2	2
Ethernet port	0	0	0	1 (TWDLCA-E40DRF only)
Cartridge slots	1	1	1	1
Largest application/ backup size (KB)	8	16	32	64
Optional memory cartridge (KB)	32[1]	32[1]	32[1]	32 or 64[2]
Optional RTC cartridge	yes[1]	yes[1]	yes[1]	RTC onboard[3]
Optional Operator Display	yes	yes	yes	yes
Optional 2nd port	no	yes	yes	yes

2.3.2. AUTÓMATOS MODULARES

Controller Item	Modular controller		
TWD...	LMDA20DUK LMDA20DTK	LMDA20DRT	LMDA40DUK LMDA40DTK
Standard digital inputs	12	12	24
Standard digital outputs	8	8	16
Max expansion I/O modules (Digital or analog)	4	7	7
Max digital inputs (controller I/O + exp I/O)	12+(4x32)=140	12+(7x32)=236	24+(7x32)=248
Max digital outputs (controller I/O + exp I/O)	8+(4x32)=136	8+(7x32)=232	16+(7x32)=240
Max digital I/O (controller I/O + exp I/O)	20+(4x32)=148	20+(7x32)=244	40+(7x32)=264
Max AS-Interface bus interface modules	2	2	2
Max I/O with AS-Interface modules (7 I/O per slave)	20+(2x62x7)=888	20+(2x62x7)=888	40+(2x62x7)=908
Max relay outputs	64 expansion only	6 base + 96 expansion	96 expansion only
Potentiometers	1	1	1
Built-in analog inputs	1	1	1
Max analog I/O (controller I/O + exp I/O)	9 in / 4 out	15 in / 7 out	15 in / 7 out
Remote controllers	7	7	7
Serial ports	2	2	2
Cartridge slots	2	2	2
Largest application/ backup size (KB)	32	64	64
Optional memory cartridge (KB)	32	32 or 64	32 or 64
Optional RTC cartridge	yes	yes	yes
Optional Operator Display	yes[2]	yes[2]	yes[2]
Optional 2nd port	yes[2]	yes[2]	yes[2]

2.4. BITS DE SISTEMA (%S)

System Bit	Function	Description	Init state	Control
%S0	Cold Start	Normally set to 0, it is set to 1 by: • A power return with loss of data (battery fault), • The user program or Animation Table Editor, • Operations Display. This bit is set to 1 during the first complete scan. It is reset to 0 by the system before the next scan.	0	S or U->S
%S1	Warm Start	Normally set to 0, it is set to 1 by: • A power return with data backup, • The user program or Animation Table Editor, • Operations Display. It is reset to 0 by the system at the end of the complete scan.	0	S or U->S
%S4 %S5 %S6 %S7	Time base: 10 ms Time base: 100 ms Time base: 1 s Time base: 1 min	The rate of status changes is measured by an internal clock. They are not synchronized with the controller scan. Example: %S4  	-	S
%S8	Wiring test	Initially set to 1, this bit is used to test the wiring when the controller is in "non-configured" state. To modify the value of this bit, use the operations display keys to make the required output status changes: • Set to 1, output reset, • Set to 0, wiring test authorized.	1	U
%S9	Reset outputs	Normally set to 0. It can be set to 1 by the program or by the terminal (in the Animation Table Editor): • At state 1, outputs are forced to 0 when the controller is in RUN mode, • At state 0, outputs are updated normally.	0	U

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user
U->S	Set to 1 by the user, reset to 0 by the system
S->U	Set to 1 by the system, reset to 0 by the user

System Bit	Function	Description	Init state	Control
%S10	I/O fault	Normally set to 1. This bit can be set to 0 by the system when an I/O fault is detected.	1	S
%S11	Watchdog overflow	Normally set to 0. This bit can be set to 1 by the system when the program execution time (scan time) exceeds the maximum scan time (software watchdog). Watchdog overflow causes the controller to change to HALT.	0	S
%S12	PLC in RUN mode	This bit reflects the running state of the controller. The systems sets the bit to 1 when the controller is running. Or to 0 for stop, init, or any other state.	0	S
%S13	First cycle in RUN	Normally at 0, this bit is set to 1 by the system during the first scan after the controller has been changed to RUN.	1	S
%S17	Capacity exceeded	Normally set to 0, it is set to 1 by the system: • During a rotate or shift operation. The system switches the bit output to 1. It must be tested by the user program, after each operation where there is a risk of an overflow, then reset to 0 by the user if an overflow occurs.	0	S->U
%S18	Arithmetic overflow or error	Normally set to 0. It is set to 1 in the case of an overflow when a 16 bit operation is performed, that is: • A result greater than + 32 767 or less than - 32 768, in single length, • A result greater than + 2 147 483 647 or less than - 2 147 483 648, in double length, • A result greater than + 3.402824E+38 or less than - 3.402824E+38, in floating point, • Division by 0, • The square root of a negative number, • BTI or ITB conversion not significant: BCD value out of limits. It must be tested by the user program, after each operation where there is a risk of an overflow, then reset to 0 by the user if an overflow occurs.	0	S->U
%S19	Scan period overrun (periodic scan)	Normally at 0, this bit is set to 1 by the system in the event of a scan period overrun (scan time greater than the period defined by the user at configuration or programmed in %SW0). This bit is reset to 0 by the user.	0	S->U

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user
U->S	Set to 1 by the user, reset to 0 by the system
S->U	Set to 1 by the system, reset to 0 by the user

System Bit	Function	Description	Init state	Control
%S20	Index overflow	Normally at 0, it is set to 1 when the address of the indexed object becomes less than 0 or more than the maximum size of an object. It must be tested by the user program, after each operation where there is a risk of overflow, then reset to 0 if an overflow occurs.	0	S->U
%S21	GRAFCET initialization	Normally set to 0, it is set to 1 by: • A cold restart, %S0=1, • The user program, in the preprocessing program part only, using a Set Instruction (S %S21) or a set coil -(S)- %S21, • The terminal. At state 1, it causes GRAFCET initialization. Active steps are deactivated and initial steps are activated. It is reset to 0 by the system after GRAFCET initialization.	0	U->S
%S22	GRAFCET reset	Normally set to 0, it can only be set to 1 by the program in pre-processing. At state 1 it causes the active steps of the entire GRAFCET to be deactivated. It is reset to 0 by the system at the start of the execution of the sequential processing.	0	U->S
%S23	Preset and freeze GRAFCET	Normally set to 0, it can only be set to 1 by the program in the pre-processing program module. Set to 1, it validates the pre-positioning of GRAFCET. Maintaining this bit at 1 freezes the GRAFCET (freezes the chart). It is reset to 0 by the system at the start of the execution of the sequential processing to ensure that the GRAFCET chart moves on from the frozen situation.	0	U->S
%S24	Operations Display	Normally at 0, this bit can be set to 1 by the user. • At state 0, the Operator Display is operating normally, • At state 1, the Operator Display is frozen, stays on current display, blinking disabled, and input key processing stopped.	0	U->S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user
U->S	Set to 1 by the user, reset to 0 by the system
S->U	Set to 1 by the system, reset to 0 by the user

System Bit	Function	Description	Init state	Control
%S31	Event mask	Normally at 1. • Set to 0, events cannot be executed and are queued. • Set to 1, events can be executed, This bit can be set to 0 by the user and the system (on cold re-start).	1	U->S
%S38	Permission for events to be placed in the events queue	Normally at 1. • Set to 0, events cannot be placed in the events queue. • Set to 1, events are placed in the events queue as soon as they are detected, This bit can be set to 0 by the user and the system (on cold re-start).	1	U->S
%S39	Saturation of the events queue	Normally at 0. • Set to 0, all events are reported, • Set to 1, at least one event is lost. This bit can be set to 0 by the user and the system (on cold re-start).	0	U->S
%S50	Updating the date and time using words %SW49 to %SW53	Normally on 0, this bit can be set to 1 or 0 by the program or the Operator Display. • Set to 0, the date and time can be read, • Set to 1, the date and time can be updated. The controller's internal RTC is updated on a falling edge of %S50.	0	U->S
%S51	Time-of-day clock status	Normally on 0, this bit can be set to 1 or 0 by the program or the Operator Display. • Set to 0, the date and time are consistent, • Set to 1, the date and time must be initialized by the user. When this bit is set to 1, the time of day clock data is not valid. The date and time may never have been configured, the battery may be low, or the controller correction constant may be invalid (never configured, difference between the corrected clock value and the saved value, or value out of range). State 1 transitioning to state 0 forces a write of the correction constant to the RTC.	0	U->S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user
U->S	Set to 1 by the user, reset to 0 by the system
S->U	Set to 1 by the system, reset to 0 by the user

System Bit	Function	Description	Init state	Control
%S52	RTC = error	This bit managed by the system indicates that the RTC correction has not been entered, and the date and time are false. • Set to 0, the date and time are consistent, • At state 1, the date and time must be initialized.	0	S
%S59	Updating the date and time using word %SW59	Normally on 0, this bit can be set to 1 or 0 by the program or the Operator Display. • Set to 0, the system word %SW59 is not managed, • Set to 1, the date and time are incremented or decremented according to the rising edges on the control bits set in %SW59.	0	U
%S66	BAT LED display enable/disable (only on controllers that support an external battery: TWDLCA•40DRF controllers.)	This system bit can be set by the user. It allows the user to turn on/off the BAT LED: • Set to 0, BAT LED is enabled (it is reset to 0 by the system at power-up), • Set to 1, BAT LED is disabled (LED remains off even if there is a low external battery power or there is no external battery in the compartment).	0	S or U->S
%S69	User STAT LED display	Set to 0, STAT LED is off. Set to 1, STAT LED is on.	0	U
%S75	External battery status (only on controllers that support an external battery: TWDLCA•40DRF controllers.)	This system bit is set by the system. It indicates the external battery status and is readble by the user: • Set to 0, external battery is operating normally, • Set to 1, external battery power is low, or external battery is absent from compartment.	0	S
%S95	Restore memory words	This bit can be set when memory words were previously saved to the internal EEPROM. Upon completion the system sets this bit back to 0 and the number of memory words restored is set in %SW97	0	U
%S96	Backup program OK	This bit can be read at any time (either by the program or while adjusting), in particular after a cold start or a warm restart. • Set to 0, the backup program is invalid. • Set to 1, the backup program is valid.	0	S
%S97	Save %MW OK	This bit can be read at any time (either by the program or while adjusting), in particular after a cold start or a warm restart. • Set to 0, save %MW is not OK. • Set to 1, save %MW is OK.	0	S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user
U->S	Set to 1 by the user, reset to 0 by the system
S->U	Set to 1 by the system, reset to 0 by the user

System Bit	Function	Description	Init state	Control
%S100	TwidoSoft communications cable connection	Shows whether the TwidoSoft communication cable is connected. • Set to 1, TwidoSoft communications cable is either not attached or TwidoSoft is connected. • Set to 0, TwidoSoft Remote Link cable is connected.	-	S
%S101	Changing a port address (Modbus protocol)	Used to change a port address using system words %SW101 (port 1) and %SW102 (port 2). To do this, %S101 must be set to 1. • Set to 0, the address cannot be changed. The value of %SW101 and %SW102 matches the current port address, • Set to 1, the address can be changed by changing the values of %SW101 (port 1) and %SW102 (port 2). Having modified the values of the system words, %S101 must be set back to 0.	0	U
%S103 %S104	Using the ASCII protocol	Enables the use of the ASCII protocol on Comm 1 (%S103) or Comm 2 (%S104). The ASCII protocol is configured using system words %SW103 and %SW105 for Comm 1, and %SW104 and %SW106 for Comm 2. • Set to 0, the protocol used is the one configured in Twido Soft, • Set to 1, the ASCII protocol is used on Comm 1 (%S103) or Comm 2 (%S104). In this case, the system words %SW103 and %SW105 must be previously configured for Comm 1, and %SW104 and %SW106 for Comm 2.	0	U
%S110	Remote link exchanges	This bit is reset to 0 by the program or by the terminal. • Set to 1 for a master, all remote link exchanges (remote I/O only) are completed. • Set to 1 for a slave, exchange with master is completed.	0	S->U
%S111	Single remote link exchange	• Set to 0 for a master, a single remote link exchange is completed. • Set to 1 for a master, a single remote link exchange is active.	0	S
%S112	Remote link connection	• Set to 0 for a master, the remote link is activated. • Set to 1 for a master, the remote link is deactivated.	0	U

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user
U->S	Set to 1 by the user, reset to 0 by the system
S->U	Set to 1 by the system, reset to 0 by the user

System Bit	Function	Description	Init state	Control
%S113	Remote link configuration/operation	• Set to 0 for a master or slave, the remote link configuration/operation is OK. • Set to 1 for a master, the remote link configuration/operation has an error. • Set to 1 for a slave, the remote link configuration/operation has an error.	0	S->U
%S118	Remote I/O error	Normally set to 1. This bit can be set to 0 when an I/O fault is detected on the remote link.	1	S
%S119	Local I/O error	Normally set to 1. This bit can be set to 0 when an I/O fault is detected on the remote link. %SW118 determines the nature of the fault. Resets to 1 when the fault disappears.	1	S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user
U->S	Set to 1 by the user, reset to 0 by the system
S->U	Set to 1 by the system, reset to 0 by the user

2.5. WORDS DE SISTEMA (%SW)

System Words	Function	Description	Control
%SW0	Controller scan period (periodic task)	Modifies controller scan period defined at configuration through the user program in the Animation Table Editor.	U
%SW6	Controller Status	Controller Status: 0 = NO CONFIG 2 = STOP 3 = RUN 4 = HALT	S

System Words	Function	Description	Control

%SW7	Controller state	• Bit [0]: Backup/restore in progress:
		  • Set to 1 if backup/restore in progress,
		  • Set to 0 if backup/restore complete or disabled.
		• Bit [1]: Controller's configuration OK:
		  • Set to 1 if configuration ok.
		• Bit [3..2] EEPROM status bits:
		  • 00 = No cartridge
		  • 01 = 32 Kb EEPROM cartridge
		  • 10 = 64 Kb EEPROM cartridge
		  • 11 = Reserved for future use
		• Bit [4]: Application in RAM different than EEPROM:
		  • Set to 1 if RAM application different to EEPROM.
		• Bit [5]: RAM application different to cartridge:
		  • Set to 1 if RAM application different to cartridge.
		• Bit [6] not used (status 0)
		• Bit [7]: Controller reserved:
		  • Set to 1 if reserved.
		• Bit [8]: Application in Write mode:
		  • Set to 1 if application is protected.
		• Bit [9] not used (status 0)
		• Bit [10]: Second serial port installed:
		  • Set to 1 if installed.
		• Bit [11]: Second serial port type: (0 = EIA RS-232, 1 = EIA RS-485):
		  • Set to 0 = EIA RS-232
		  • Set to 1 = EIA RS-485
		• Bit [12]: application valid in internal memory:
		  • Set to 1 if application valid.
		• Bit [13] Valid application in cartridge:
		  • Set to 1 if application valid.
		• Bit [14] Valid application in RAM:
		  • Set to 1 if application valid.
		• Bit [15]: ready for execution:
		  • Set to 1 if ready for execution.
			S

%SW11	Software watchdog value	Contains the maximum value of the watchdog. The value (10 to 500 ms) is defined by the configuration.	U

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

System Words	Function	Description	Control
%SW17	Default status for floating operation	When a fault is detected in a floating arithmetic operation, bit %S18 is set to 1 and the default status of %SW17 is updated according to the following coding: • Bit [0]: Invalid operation, result is not a number (1.#NAN or -1.#NAN), • Bit 1: Reserved, • Bit 2: Divided by 0, result is infinite (-1.#INF or 1.#INF), • Bit 3: Result greater in absolute value than +3.402824e+38, result is infinite (-1.#INF or 1.#INF).	S and U
%SW18-%SW19	100 ms absolute timer counter	The counter works using two words: • **%SW18** represents the least significant word, • **%SW19** represents the most significant word.	S and U
%SW30	Last scan time	Shows execution time of the last controller scan cycle (in ms). **Note:** This time corresponds to the time elapsed between the start (acquisition of inputs) and the end (update of outputs) of a scan cycle.	S
%SW31	Max scan time	Shows execution time of the longest controller scan cycle since the last cold start (in ms). **Notes:** • This time corresponds to the time elapsed between the start (acquisition of inputs) and the end (update of outputs) of a scan cycle. • To allow proper detection when a pulse signal is provided on input, the pulse period (T_{pulse}) of that signal must be longer than twice the maximum scan time recorded in system word %SW31, as specified by the following condition: [$T_{pulse} \geq 2$ x %SW31].	S
%SW32	Min. scan time	Shows execution time of shortest controller scan cycle since the last cold start (in ms). **Note:** This time corresponds to the time elapsed between the start (acquisition of inputs) and the end (update of outputs) of a scan cycle.	S
%SW48	Number of events	Shows how many events have been executed since the last cold start. **Note:** Set to 0 (after application loading and cold start), increments on each event execution.	S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

System Words	Function	Description		Control
%SW49 %SW50 %SW51 %SW52 %SW53	Real-Time Clock (RTC)	RTC Functions: words containing current date and time values (in BCD):		S and U
		%SW49	xN Day of the week (N=1 for Monday)	
		%SW50	00SS Seconds	
		%SW51	HHMM Hour and minute	
		%SW52	MMDD Month and day	
		%SW53	CCYY Century and year	
		These words are controlled by the system when bit **%S50** is at 0. These words can be written by the user program or by the terminal when bit **%S50** is set to 1. On a falling edge of **%S50** the controller's internal RTC is updated from the values written in these words.		
%SW54 %SW55 %SW56 %SW57	Date and time of the last stop	System words containing the date and time of the last power failure or controller stop (in BCD):		S
		%SW54	SS Seconds	
		%SW55	HHMM Hour and minute	
		%SW56	MMDD Month and day	
		%SW57	CCYY Century and year	
%SW58	Code of last stop	Displays code giving cause of last stop:		S
		1 =	Run/Stop input edge	
		2 =	Stop at software fault (controller scan overshoot)	
		3 =	Stop command	
		4 =	Power outage	
		5 =	Stop at hardware fault	

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

System Word	Function	Description			Control
%SW59	Adjust current date	Adjusts the current date. Contains two sets of 8 bits to adjust current date. The operation is always performed on rising edge of the bit. This word is enabled by bit **%S59**.			U
		Increment	**Decrement**	**Parameter**	
		bit 0	bit 8	Day of week	
		bit 1	bit 9	Seconds	
		bit 2	bit 10	Minutes	
		bit 3	bit 11	Hours	
		bit 4	bit 12	Days	
		bit 5	bit 13	Month	
		bit 6	bit 14	Years	
		bit 7	bit 15	Centuries	
%SW60	RTC correction	RTC correction value			U
%SW63	EXCH1 block error code	EXCH1 error code: 0 - operation was successful 1 – number of bytes to be transmitted is too great (> 250) 2 - transmission table too small 3 - word table too small 4 - receive table overflowed 5 - time-out elapsed 6 - transmission 7 - bad command within table 8 - selected port not configured/available 9 - reception error 10 - can not use %KW if receiving 11 - transmission offset larger than transmission table 12 - reception offset larger than reception table 13 - controller stopped EXCH processing			S
%SW64	EXCH2 block error code	EXCH2 error code: See %SW63.			S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

System Word	Function	Description	Control
%SW65	EXCH3 block error code	EXCH3 error code is implemented on Ethernet-capable TWDLCAE40DRF Twido controllers only 1-4, 6-13: See %SW63. (Note that eror code 5 is invalid and replaced by the Ethernet-specific error codes 109 and 122 described below.) The following are dedicated to Modbus response: 81 - slave (server) PLC returns ILLEGAL FUNCTION response 82 - slave (server) PLC returns ILLEGAL DATA ADDRESS response 83 - slave (server) PLC returns ILLEGAL DATA VALUE response 84 - slave (server) PLC returns SLAVE DEVICE FAILURE response 85 - slave (server) PLC returns ACKNOWLEDGE response 86 - slave (server) PLC returns SLAVE DEVICE BUSY response 87 - slave (server) PLC returns NEGATIVE ACKNOWLEDGE response 88 - slave (server) PLC returns MEMORY PARITY ERROR response The following are Ethernet-specific error codes: 101 - no such IP address 102 - the TCP connection is broken 103 - no socket available (all connection channels are busy) 104 - network is down 105 - network cannot be reached 106 - network dropped connection on reset 107 - connection aborted by peer device 108 - connection reset by peer device 109 - connection time-out elapsed 110 - rejection on connection attempt 111 - host is down 120 - unknown index (remote device is not indexed in configuration table) 121 - fatal (MAC, Chip, Duplicated IP)122 - receiving timed-out elapsed after data was sent 123 - Ethernet initialization in progress	S
%SW67	Function and type of controller	Contains the following information: • Controller type bits [0 -11] • 8B0 = TWDLC•A10DRF • 8B1 = TWDLC•A16DRF • 8B2 = TWDLMDA20DUK/DTK • 8B3 = TWDLC•A24DRF • 8B4 = TWDLMDA40DUK/DTK • 8B6 = TWDLMDA20DRT • 8B8 = TWDLCAA40DRF • 8B9 = TWDLCAE40DRF • Bit 12,13,14,15 not used = 0	S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

System Words	Function	Description	Control
%SW73 and %SW74	AS-Interface System State	• Bit [0]: Set to 1 if configuration OK. • Bit [1]: Set to 1 if data exchange enabled. • Bit [2]: Set to 1 if module in Offline mode. • Bit [3]: Set to 1 if ASI_CMD instruction terminated. • Bit [4]: Set to 1 error in ASI_CMD instruction in progress.	S and U
%SW76 to %SW79	Down counters 1-4	These 4 words serve as 1 ms timers. They are decremented individually by the system every ms if they have a positive value. This gives 4 down counters down counting in ms which is equal to an operating range of 1 ms to 32767 ms. Setting bit 15 to 1 can stop decrementation.	S and U
%SW80	Base I/O Status	Bit [0] Channels in normal operation (for all its channels) Bit [1] Module under initialization (or of initializing information of all channels) Bit [2] Hardware failure (external power supply failure, common to all channels) Bit [3] Module configuration fault Bit [4] Converting data input channel 0 in progress Bit [5] Converting data input channel 1 in progress Bit [6] Input thermocouple channel 0 not configured Bit [7] Input thermocouple channel 1 not configured Bit [8] Not used Bit [9] Unused Bit [10] Analog input data channel 0 over range Bit [11] Analog input data channel 1 over range Bit [12] Incorrect wiring (analog input data channel 0 below current range, current loop open) Bit [13] Incorrect wiring (analog input data channel 1 below current range, current loop open) Bit [14] Unused Bit [15] Output channel not available	
%SW81	Expansion I/O Module 1 Status: Same definitions as %SW80		
%SW82	Expansion I/O Module 2 Status: Same definitions as %SW80		
%SW83	Expansion I/O Module 3 Status: Same definitions as %SW80		
%SW84	Expansion I/O Module 4 Status: Same definitions as %SW80		
%SW85	Expansion I/O Module 5 Status: Same definitions as %SW80		
%SW86	Expansion I/O Module 6 Status: Same definitions as %SW80		
%SW87	Expansion I/O Module 7 Status: Same definitions as %SW80		
%SW81 to %SW87	Expansion module status		

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

System Words	Function	Description	Control

%SW96	Command and/or diagnostics for save/restore function of application program and %MW.	• Bit [0]: Indicates that the %MW memory words must be saved to EEPROM:
		  • Set to 1 if a backup is required,
		  • Set to 0 if the backup in progress is not complete.
		• Bit [1]: This bit is set by the firmware to indicate when the save is complete:
		  • Set to 1 if the backup is complete,
		  • Set to 0 if a new backup request is asked for.
		• Bit [2]: Backup error, refer to bits 8, 9, 10 and 14 for further information:
		  • Set to 1 if an error appeared,
		  • Set to 0 if a new backup request is asked for.
		• Bit [6]: Set to 1 if the controller contains an empty application.
		• Bit [8]: Indicates that the number of %MWs specified in %SW97 is greater than the number of %MWs configured in the application:
		  • Set to 1 if an error is detected,
		• Bit [9]: Indicates that the number of %MWs specified in %SW97 is greater than the maximum number of %MWs that can be defined by any application in TwidoSoft.
		  • Set to 1 if an error is detected,
		• Bit [10]: Difference between internal RAM and internal EEPROM (1 = yes).
		  • Set to 1 if there is a difference.
		• Bit [14]: Indicates if an EEPROM write fault has occurred:
		  • Set to 1 if an error is detected,
			S and U

%SW97	Command or diagnostics for save/restore function	When saving memory words, this value represents the physical number %MW to be saved to internal EEPROM. When restoring memory words, this value is updated with the number of memory words restored to RAM. For the save operation, when this number is set to 0, memory words will not be stored. The user must define the user logic program. Otherwise, this program is set to 0 in the controller application, except in the following case: On cold start, this word is set to -1 if the internal Flash EEPROM has no saved memory word **%MW** file. In the case of a cold start where the internal Flash EEPROM contains a memory word **%MW** list, the value of the number of saved memory words in the file must be set in this system word **%SW97**.	S and U

System Words	Function	Description	Control
%SW101 %SW102	Value of the port's Modbus address	When bit %S101 is set to 1, you can change the Modbus address of port 1 or port 2. The address of port 1 is %SW101, and that of port 2 is %SW102.	S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

<table>
<tr><th>System Words</th><th>Function</th><th>Description</th><th>Control</th></tr>
<tr><td>%SW103
%SW104</td><td>Configuration for use of the ASCII protocol</td><td>When bit %S103 (Comm 1) or %S104 (Comm 2) is set to 1, the ASCII protocol is used. System word %SW103 (Comm 1) or %SW104 (Comm 2) must be set according to the elements below:
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="8">End of the character string</td><td>Data bit</td><td>Stop bit</td><td colspan="2">Parity</td><td>RTS/ CTS</td><td colspan="3">Baud rate</td></tr>
</table>

Baud rate:

0: 1200 bauds,
1: 2400 bauds,
2: 4800 bauds,
3: 9600 bauds,
4: 19200 bauds,
5: 38400 bauds.

RTS/CTS:

0: disabled,
1: enabled.

Parity:

00: none,
10: odd,
11: even.

Stop bit:

0: 1 stop bit,
1: 2 stop bits.

Data bits:

0: 7 data bits,
1: 8 data bits.

</td><td>S</td></tr>
<tr><td>%SW105
%SW106</td><td>Configuration for use of the ASCII protocol</td><td>When bit %S103 (Comm 1) or %S104 (Comm 2) is set to 1, the ASCII protocol is used. System word %SW105 (Comm 1) or %SW106 (Comm 2) must be set according to the elements below:
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="8">Timeout frame in ms</td><td colspan="8">Timeout response
in multiple of 100 ms</td></tr>
</table></td><td>S</td></tr>
<tr><td>%SW111</td><td>Remote link status</td><td>Indication: Bit 0 corresponds to remote controller 1, bit 1 to remote controller 2, etc.
Bit [0] to [6]:

Set to 0 = remote controller 1-7 absent
Set to 1 = remote controller 1-7 present

Bit [8] to bit [14]:

Set to 0 = remote I/O detected on remote controller 1-7
Set to 1 = extension controller detected on remote controller 1-7
</td><td>S</td></tr>
</table>

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

System Words	Function	Description	Control
%SW112	Remote Link configuration/ operation error code	00: successful operations 01: timeout detected (slave) 02: checksum error detected (slave) 03: configuration mismatch (slave) This is set to 1 by the system and must be reset by the user.	S
%SW113	Remote link configuration	Indication: Bit 0 corresponds to remote controller 1, bit 1 to remote controller 2, etc. Bit [0] to [6]: • Set to 0 = remote controller 1-7 not configured • Set to 1 = remote controller 1-7 configured Bit [8] to bit [14]: • Set to 0 = remote I/O configured as remote controller 1-7 • Set to 1 = peer controller configured as remote controller 1-7	S
%SW114	Enable schedule blocks	Enables or disables operation of schedule blocks by the user program or operator display. Bit 0: 1 = enables schedule block #0 ... Bit 15: 1 = enables schedule block #15 Initially all schedule blocks are enabled. If schedule blocks are configured the default value is FFFF If no schedule blocks are configured the default value is 0.	S and U
%SW118	Base controller status word	Shows faults detected on master controller. Bit 9: 0 = External fault or comm. Fault Bit 12: 0 = RTC not installed Bit 13: 0 = Configuration fault (I/O extension configured but absent or faulty). All the other bits of this word are set to 1 and are reserved. For a controller which has no fault, the value of this word is FFFFh.	S
%SW120	Expansion I/O module health	One bit per module. Address 0 = Bit 0 1 = Unhealthy 0 = OK	S

Abbreviation	Description
S	Controlled by the system
U	Controlled by the user

2.6. GAMA LIMITE DAS FUNÇÕES ARITMÉTICAS EM VÍRGULA FLUTUANTE

Arithmetic Funtion		Limit range and invalid operations	
Type	**Syntax**	**#QNAN (Invalid)**	**#INF (Infinite)**
Square root of an operand	SQRT(x)	x < 0	x > 1.7E38
Power of an integer by a real EXPT(%MF,%MW)	EXPT(y, x) (where: x^y = %MW^%MF)	x < 0	y.ln(x) > 88
Base 10 logarithm	LOG(x)	x <= 0	x > 2.4E38
Natural logarithm	LN(x)	x <= 0	x > 1.65E38
Natural exponential	EXP(x)	x < 0	x > 88.0

2.7. COMPATIBILIDADE DE HARDWARE EM DOUBLE WORD

Twido controller	Double words supported	Floating points supported
TWDLMDA40DUK	Yes	Yes
TWDLMDA40DTK	Yes	Yes
TWDLMDA20DUK	Yes	No
TWDLMDA20DTK	Yes	No
TWDLMDA20DRT	Yes	Yes
TWDLCA•40DRF	Yes	Yes
TWDLC•A24DRF	Yes	No
TWDLC•A16DRF	Yes	No
TWDLC•A10DRF	No	No

2.8. TIPOS DE OBJECTOS DISPONÍVEIS PARA ESTRUTURAS

2.8.1. BITS

Type	Address	Maximum size	Write access
Discrete input bits	%I0.0:L or %I1.0:L (1)	0<L<17	No
Discrete output bits	%Q0.0:L or %Q1.0:L (1)	0<L<17	Yes
System bits	%Si:L with i multiple of 8	0<L<17 and i+L≤ 128	Depending on i
Grafcet Step bits	%Xi:L with i multiple of 8	0<L<17 and i+L≤ 95 (2)	Yes (by program)
Internal bits	%Mi:L with i multiple of 8	0<L<17 and i+L≤ 256 (3)	Yes

Key:
1. Only I/O bits 0 to 16 can be read in bit string. For controllers with 24 inputs and 32 I/O modules, bits over 16 cannot be read in bit string.
2. Maximum of i+L for TWWDLCAA10DRF and TWDLCAA16DRF is 62
3. Maximum of i+L for TWWDLCAA10DRF and TWDLCAA16DRF is 128

2.8.2. WORDS

Type	Address	Maximum size	Write access
Internal words	%MWi:L	0<L<256 and i+L< 3000	Yes
Constant words	%KWi:L	0<L<256 and i+L< 256	No
System Words	%SWi:L	0<L and i+L<128	Depending on i

2.8.3. WORDS DUPLAS

Type	Address	Maximum size	Write access
Internal words	%MDi:L	0<L<256 and i+L< 3000	Yes
Constant words	%KDi:L	0<L and i+L< 256	No

2.8.4. VÍRGULA FLUTUANTE

Type	Address	Maximum size	Write access
Internal words	%MFi:L	0<L<256 and i+L< 3000	Yes
Constant words	%KFi:L	0<L and i+L<256	No

2.9. TIPOS DE OBJECTOS DISPONÍVEIS PARA INDEXAÇÃO

Type	Address	Maximum size	Write access
Internal words	%MWi[MWj]	0≤ i+%MWj<3000	Yes
Constant words	%KWi[%MWj]	0≤ i+%MWj<256	No
Internal double words	%MDi[MWj]	0≤ i+%MWj<2999	Yes
Double constant words	%KDi[%MWj]	0≤ i+%MWj<255	No
Internal floating points	%MFi[MWj]	0≤ i+%MWj<2999	Yes
Constant floating points	%KFi[%MWj]	0≤ i+%MWj<255	No

2.10. UTILIZAÇÃO DA MEMÓRIA

2.10.1. RAM EXTERNA

Introduction

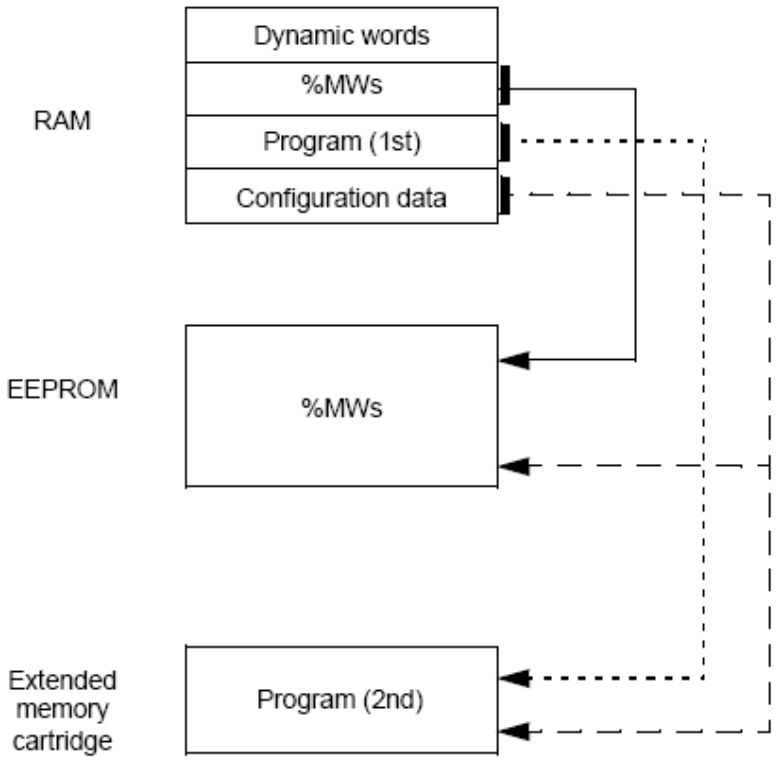
The following information details using the memory functions in modular controllers using a 64K extended memory cartridge.

At a Glance

The 64K extended memory cartridge is used to extend the program memory capability of your Twido controller from 32K to 64K. It must remain plugged into the controller as long as the extended program is being used. If the cartridge is removed the controller will enter the stopped state. Memory words are still backed up into the EEPROM in the controller. Dynamic data can be stored in memory words then backed up to the EEPROM. The 64K extended memory cartridge has the same power up behavior as the 32K backup cartridge.

Memory Structure

Here is a diagram of a controller's memory structure using an extended memory cartridge. The arrows show what is backed up into the EEPROM and the 64K extended memory cartridge from RAM:



Configure Software and Install Extended Memory

Before you begin writing your extended program, you must install the 64K extended memory cartridge into your controller. The following four steps show you how:

Step	Action
1	Under the Hardware option menu on you Twido software window enter 'TWDXCPMFK64'.
2	Power down the controller.
3	Plug in the 64K extended memory cartridge.
4	Powerup the controller.

Save your program.

Once your 64K extended memory cartridge has been installed and your program written:

- From the Twido software window bring down the menu under 'Controller', scroll down to 'Backup' and click on it.

Data (%MWs) Backup

Here are the steps for backing up data (memory words) into the EEPROM:

Step	Action
1	For this to work the following must be true: A valid program is present Memory words are configured in the program.
2	Set %SW97 to the length of the memory words to be saved. **Note:** Length cannot exceed the configured memory word length, and it must be greater than 0 but not greater than 512.
3	Set %SW96:X0 to 1.

Data (%MWs) Restore

Restore %MWs manually by setting system bit %S95 to 1.
For this to work the following must be true:

- A valid program is present
- The backup memory words are valid

2.10.2. EEPROM INTERNA

Introduction

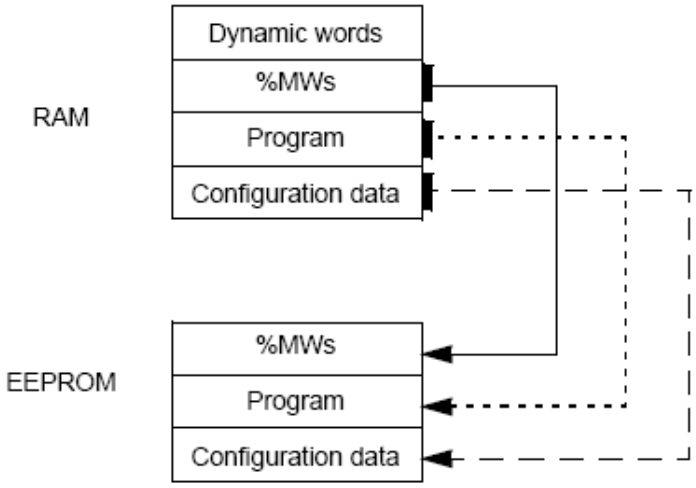
The following information details backup and restore memory functions in modular and compact controllers without a backup cartridge or extended memory plugged in.

At a Glance

Twido programs, memory words and configuration data can be backed up using the controllers internal EEPROM. Because saving a program to the internal EEPROM clears any previously backed up memory words, the program must be backed up first, then the configured memory words. Dynamic data can be stored in memory words then backed up to the EEPROM. If there is no program saved to the internal EEPROM you cannot save memory words to it.

Memory Structure

Here is a diagram of a controller's memory structure. The arrows show what can be backed up to the EEPROM from RAM:



Program Backup

Here are the steps for backing up your program into EEPROM.

Step	Action
1	The following must be true: There is a valid program in RAM.
2	From the Twido software window bring down the menu under 'Controller', scroll down to 'Backup' and click on it.

Program Restore

During power up there is one way the program will be restored to RAM from the EEPROM (assuming there is no cartridge or extended memory in place):

- The RAM program is not valid

To restore a program manually from EEPROM do the following:

- From the Twido software window bring down the menu under 'Controller', scroll down to 'Restore' and click on it.

Data (%MWs) Backup

Here are the steps for backing up data (memory words) into the EEPROM:

Step	Action
1	For this to work the following must be true: A valid program in RAM (%SW96:X6=1). The same valid program already backed up into the EEPROM. Memory words configured in the program.
2	Set %SW97 to the length of the memory words to be saved. **Note:** Length cannot exceed the configured memory word length, and it must be greater than 0 but not greater than 512.
3	Set %SW96:X0 to 1.

Data (%MWs) Restore

Restore %MWs manually by setting system bit %S95 to 1.
For this to work the following must be true:

- A valid backup application is present in the EEPROM
- The application in RAM matches the backup application in EEPROM
- The backup memory words are valid

2.10.3. EEPROM EXTERNA

Introduction

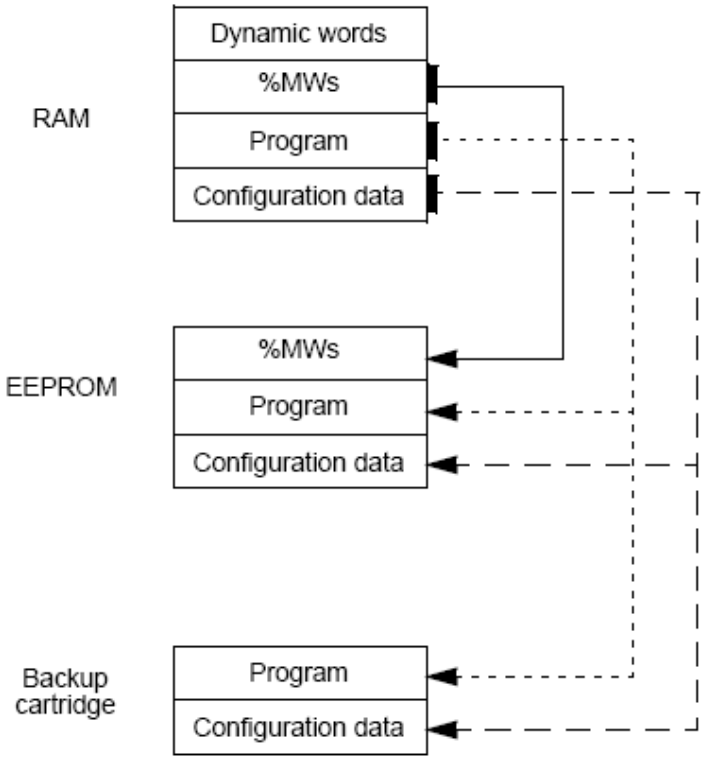
The following information details backup and restore memory functions in modular and compact controllers using a 32K backup cartridge.

At a Glance

The backup cartridge is used to save a program and transfer that program to other Twido controllers. It should be removed from a controller and set aside once the program has been installed or saved. Only program and configuration data can be saved to the cartridge (%MWs cannot be saved to the 32K backup cartridge). Dynamic data can be stored in memory words then backed up to the EEPROM. When program installation is complete any %MWs that were backed up to the internal EEPROM prior to installation will be lost.

Memory Structure

Here is a diagram of a controller's memory structure with the backup cartridge attached. The arrows show what can be backed up to the EEPROM and cartridge from RAM:



Program Backup

Here are the steps for backing up your program into the backup cartridge:

Step	Action
1	Power down the controller.
2	Plug in the backup cartridge.
3	Powerup the controller.
4	From the Twido software window bring down the menu under 'Controller', scroll down to 'Backup' and click on it.
5	Power down the controller.
6	Remove backup cartridge from controller.

Program Restore

To load a program saved on a backup cartridge into a controller do the following:

Step	Action
1	Power down the controller.
2	Plug in the backup cartridge.
3	Powerup the controller. (If Auto Start is configured you must power cycle again to get to run mode.)
4	Power down the controller.
5	Remove backup cartridge from controller.

Data (%MWs) Backup

Here are the steps for backing up data (memory words) into the EEPROM:

Step	Action
1	For this to work the following must be true: A valid program in RAM. The same valid program already backed up into the EEPROM. Memory words configured in the program.
2	Set %SW97 to the length of the memory words to be saved. **Note** Length cannot exceed the configured memory word length, and it must be greater than 0 but not greater than 512.
3	Set %SW96:X0 to 1.

Data (%MWs) Restore

Restore %MWs manually by setting system bit %S95 to 1.
For this to work the following must be true:

- A valid backup application is present in the EEPROM
- The application in RAM matches the backup application in EEPROM
- The backup memory words are valid