Control Bit Definition
Rev-f

Range = 0 - 2047

First byte of each pair = low address 0 – 255

Second byte of each pair adds high address bits plus:

- port direction	**d**:	1 = input	0 = output
- switch input	**t**:	1 = toggle	0 = normal
- input report	**t**:	1 = precision	0 = normal
- enable signal	**s**:	1 = signal port	0 = normal

SV1-SV16 = Port Starting Addresses and direction. (sets the first of 8 line addresses for each port)

Factory default values:

SV 1 = 0 SV 2 = 0 (1- 8 output)
SV 3 = 8 SV 4 = 0 (9-16 output)
SV 5 = 16 SV 6 = 0 (17-24 output)
SV 7 = 24 SV 8 = 0 (25-32 output)
SV 9 = 32 SV10 = 0 (33-40 output)
SV11 = 32 SV12 = 0 (41-48 output)
SV13 = 32 SV14 = 0 (49-56 output)
SV15 = 32 SV16 = 0 (57-64 output)

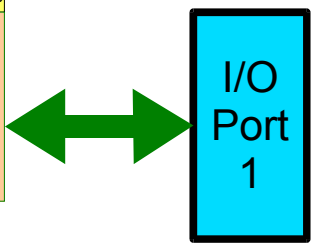
SV23-278 I/O line control words and Secondary message control words, configured in groups of 4 bytes per line.

Port 1

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV1
SV2 8x = in 0x = out

Control-Operation	Secondary Message
line1=SV23-24	SV25 -SV26
line2=SV27-28	SV29 -SV30
line3=SV31-32	SV33 -SV34
line4=SV35-36	SV37 -SV38
line5=SV39-40	SV41 -SV42
line6=SV43-44	SV45 -SV46
line7=SV47-48	SV49 -SV50
line8=SV51-52	SV53 -SV54

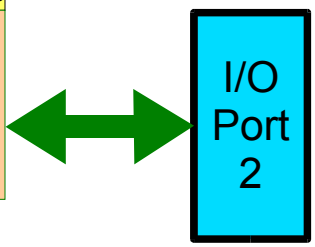


Port 2

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV3 8x = in 0x = out
SV4

Control-Operation	Secondary Message
line1=SV55-56	SV57 - SV58
line2=SV59-60	SV61 - SV62
line3=SV63-64	SV65 - SV66
line4=SV67-68	SV69 - SV70
line5=SV71-72	SV73 - SV74
line6=SV75-76	SV77 - SV78
line7=SV79-80	SV81 - SV82
line8=SV83-84	SV85 - SV86

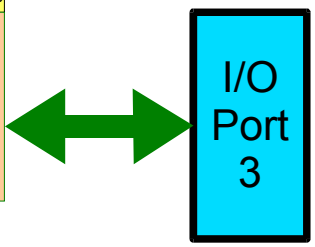


Port 3

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV5
SV6 8x = in 0x = out

Control-Operation	Secondary Message
line1=SV87 - 88	SV89 -SV90
line2=SV91 - 92	SV93 -SV94
line3=SV95 - 96	SV97 -SV98
line4=SV99 - 100	SV101-SV102
line5=SV103-104	SV105-SV106
line6=SV107-108	SV109-SV110
line7=SV111-112	SV113-SV114
line8=SV115-116	SV117-SV118

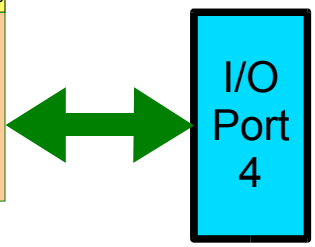


Port 4

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV7
SV8 8x = in 0x = out

Control-Operation	Secondary Message
line1=SV119-120	SV121-SV122
line2=SV123-124	SV125-SV126
line3=SV127-128	SV129-SV130
line4=SV131-132	SV133-SV134
line5=SV135-136	SV137-SV138
line6=SV139-140	SV141-SV142
line7=SV143-144	SV145-SV146
line8=SV147-148	SV149-SV150

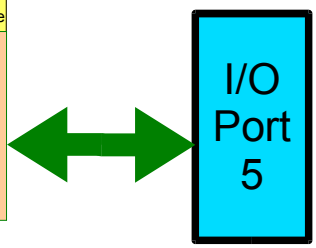


Port 5

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV9
SV10 8x = in 0x = out

Control-Operation	Secondary Message
line1=SV151-152	SV153-SV154
line2=SV155-156	SV157-SV158
line3=SV159-160	SV161-SV162
line4=SV163-164	SV165-SV166
line5=SV167-168	SV169-SV170
line6=SV171-172	SV173-SV174
line7=SV175-176	SV177-SV178
line8=SV179-180	SV181-SV182

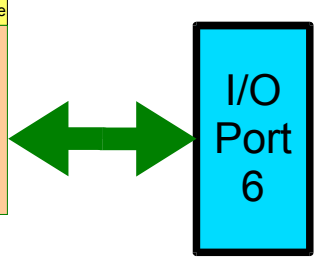


Port 6

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV11
SV128x = in 0x = out

Control-Operation	Secondary Message
line1=SV183-184	SV185-SV186
line2=SV187-188	SV189-SV190
line3=SV191-192	SV193-SV194
line4=SV195-196	SV197-SV198
line5=SV199-200	SV201-SV202
line6=SV203-204	SV205-SV206
line7=SV207-208	SV209-SV210
line8=SV211-212	SV213-SV214

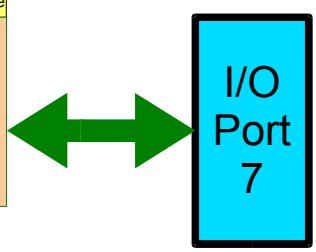


Port 7

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV13
SV14 8x = in 0x = out

Control-Operation	Secondary Message
line1=SV215-216	SV217-SV218
line2=SV219-220	SV221-SV222
line3=SV223-224	SV225-SV226
line4=SV227-228	SV229-SV230
line5=SV231-232	SV233-SV234
line6=SV235-236	SV237-SV238
line7=SV239-240	SV241-SV242
line8=SV243-244	SV245-SV246

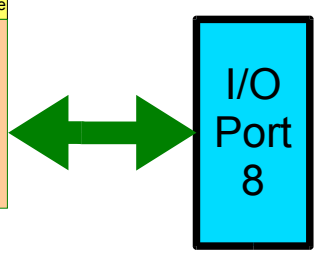


Port 8

a	a	a	a	a	a	a	a
d	t	s	-	-	h	h	h

SV15
SV16 8x = in 0x = out

Control-Operation	Secondary Message
line1=SV247-248	SV249-SV150
line2=SV251-252	SV253-SV254
line3=SV255-256	SV257-SV258
line4=SV259-260	SV261-SV262
line5=SV263-264	SV265-SV266
line6=SV267-268	SV269-SV270
line7=SV271-272	SV273-SV274
line8=SV275-276	SV277-SV278



SV17-18 = Ops Mode Address
To program Ops address in service mode, press and hold push button, then set SV17-18 to desired address.

SV18 Ops Mode Address

a	a	a	a	a	a	a	a

a = Low Address Bits

SV17 Ops Mode Address

1	1	h	h	h	h	h	h

h = High address Bits

SV19 = Configuration Options
To program configuration options in service mode, press and hold push button, then set SV19 to desired value .

SV19 Configuration options

m	-	-	-	s	g	o	1
m	-	-	-	s	g	1	p
m	-	-	-	s	1	o	p
m	-	-	-	1	g	o	p
1	-	-	-	s	g	o	p

x1 enable **p**ort state memory
x2 enable **o**ps mode program
x4 enable **g**pon interrogate
x8 enable **s**pecial interrogate
8x enable **m**aster mode

SV20 = Reserved

SV21 = Software Version (read only)
(Send AA to restore Factory defaults)

SV 21 Read = Software Version Number
Write = AA to Restore factory defaults

x	x	x	x	x	x	x	x

SV22 = Mfg. ID (87 read only = RR-CirKits)

SV 22 Manufacturer (87)

0	1	0	1	0	1	1	1

SV23-278 I/O line control words and Secondary message control words, configured in groups of 4 bytes per line. (see previous page)

Per Line Bit Definition

Byte One - SV23 etc. Message Type & Input Transition Control

5 Bits control Input/Output (green)
2 bits control Secondary message (orange)

d	-	m	m	s	s	t	t

d = direction m = mode s = secondary (transition) t = transition (input)

Direction

Input Mode only

Input Command Direction

0	-	m	m	s	s	t	t
1	-	m	m	s	s	t	t

0x ↑=close ↓=throw ↑=closed ↓=thrown ↑=hi ↓=low

8x ↑=throw ↓=close ↑=thrown ↓=closed ↑=low ↓=hi

Message type

Input Mode

Input Response Type

d	-	0	0	s	s	t	t
d	-	0	1	s	s	t	t
d	-	1	0	s	s	t	t
d	-	1	1	s	s	t	t

0x send switch request

1x send switch feedback message

2x send general sensor message

4x Reserved

Output Mode

Output Responds To

d	-	0	0	s	s	t	t
d	-	0	1	s	s	t	t
d	-	1	0	s	s	t	t
d	-	1	1	s	s	t	t

0x switch request (B0)

1x switch feedback (B1)

2x general sensor (B2)

4x Reserved

Secondary Transition Control

Input and Output Modes

d	-	m	m	0	0	t	t
d	-	m	m	0	1	t	t
d	-	m	m	1	0	t	t
d	-	m	m	1	1	t	t

x0 no secondary message sent or received

x4 send/respond on low to high transition ↑

x8 send/respond on high to low transition ↓

xC send/respond on both transitions ↕

Input Transition Control

Input Mode only

d	-	m	m	s	s	0	0
d	-	m	m	s	s	0	1
d	-	m	m	s	s	1	0
d	-	m	m	s	s	1	1

x0 no input message sent

x1 send on low to high transition ↑

x2 send on high to low transition ↓

x3 send on both transitions ↕

Per Line Bit Definition

Byte Two - SV24 etc. Input / Output Control

8 Bits control Input and Output Messages

i	t	t	t	T	T	T	T

i = invert t=type T=Timing

Output Invert

0	t	t	t	T	T	T	T	0x normal output
1	t	t	t	T	T	T	T	8x invert output

Input / Output type

i	0	0	0	T	T	T	T	0x output: short pulse / input: debounce
i	0	0	1	T	T	T	T	1x output: long pulse
i	0	1	0	T	T	T	T	2x output: short blink / input: toggle 'on' time
i	0	1	1	T	T	T	T	3x output: long blink
i	1	0	0	T	T	T	T	4x reserved
i	1	0	1	T	T	T	T	5x reserved
i	1	1	0	T	T	T	T	6x reserved
i	1	1	1	T	T	T	T	7x reserved

Input / Output Timing

									short	long	4th aspect *
i	t	t	t	0	0	0	0	x0	Steady **	10 sec.	yellow
i	t	t	t	0	0	0	1	x1	0.2 sec.	15 sec.	alt. green / yellow
i	t	t	t	0	0	1	0	x2	0.3 sec.	20 sec.	alt. red / yellow
i	t	t	t	0	0	1	1	x3	0.4 sec.	30 sec.	blinking yellow *
i	t	t	t	0	1	0	0	x4	0.5 sec.	40 sec.	alt. yellow / green
i	t	t	t	0	1	0	1	x5	0.6 sec.	50 sec.	green
i	t	t	t	0	1	1	0	x6	0.8 sec.	1 min.	alt. red / green
i	t	t	t	0	1	1	1	x7	1 sec.	1.5 min.	blinking green *
i	t	t	t	1	0	0	0	x8	1.25 sec.	2 min.	alt. yellow / red
i	t	t	t	1	0	0	1	x9	1.5 sec.	3 min.	alt. green / red
i	t	t	t	1	0	1	0	xA	2 sec.	4 min.	red
i	t	t	t	1	0	1	1	xB	3 sec.	5 min.	blinking red *
i	t	t	t	1	1	0	0	xC	4 sec.	6 min.	blinking yellow *
i	t	t	t	1	1	0	1	xD	5 sec.	7 min.	blinking green *
i	t	t	t	1	1	1	0	xE	6 sec.	8 min.	blinking red *
i	t	t	t	1	1	1	1	xF	8 sec.	10 min.	dark *

* The associated port control byte (SV3 <2x> etc.) needs to have “signal” enabled.

When no light is connected to the 4th output aspect of a signal head (like in a three aspect signal), flashing aspects can be used on the respective signal head.

To setup a flashing signal, two SV's are required:
1st, 3rd, 5th and 7th lines: this output byte controls the timing of the flashing aspect;
2nd, 4th, 6th and 8th lines: this output byte selects the two alternating aspect colors (3rd column). Normally one of these will be “dark” but that is not required.

** Output: steady;
Input: no debounce / 0.2 sec. toggle 'on' time.

Per Line Bit Definition

Bytes Three and Four - SV25-26 etc. Secondary Message Control

Secondary Output Message uses two SVs for each line.

Byte Three - Secondary low address bits

a	a	a	a	a	a	a	a

Sec. Address

Byte Four - Secondary Control
1 bit controls polarity for response
2 bits control Secondary message type
4 Bits control Secondary high address bits

p	d	t	t	h	h	h	h

Sec. Control

Secondary Command **d**irection

0	p	t	t	h	h	h	h	a	a	a	a	a	a	a	a	0x xx Send Secondary Message
1	p	t	t	h	h	h	h	a	a	a	a	a	a	a	a	8x xx Receive Secondary Message

Byte Four Byte Three

Secondary Command **p**olarity

d	0	t	t	h	h	h	h	a	a	a	a	a	a	a	a	0x xx ↑=close ↓=throw ↑=closed ↓=thrown ↑=hi ↓=low
d	1	t	t	h	h	h	h	a	a	a	a	a	a	a	a	4x xx ↑=throw ↓=close ↑=thrown ↓=closed ↑=low ↓=hi

Byte Four Byte Three

Secondary message **t**ype Control

d	p	0	0	h	h	h	h	a	a	a	a	a	a	a	a	0x xx switch request (close - throw)
d	p	0	1	h	h	h	h	a	a	a	a	a	a	a	a	1x xx switch feedback message (closed - thrown)
d	p	1	0	h	h	h	h	a	a	a	a	a	a	a	a	2x xx general sensor message (high - low)
d	p	1	1	h	h	h	h	a	a	a	a	a	a	a	a	3x xx Reserved

Byte Four Byte Three

d = direction
p = polarity
t = type
h = High address Bits
a = Low Address Bits

Secondary messages are optionally sent on the detection of any change of input or output state (or on both changes). Secondary messages may optionally be received at any address and will trigger the same action as the primary address.

Address Range = 0 – 2047 for turnouts; 0 – 4095 for sensors.

Any type of message may be sent to, or received at, any address (do not send to itself, or a tight loop may occur).

Byte one controls the I/O transition that triggers the message. Bytes three and four control the type of message, if the message is to be sent or received, and it's address.

The normal use of Secondary Output Messages is to create cascaded commands. One example would be to implement a yard ladder. Another would be to sequence a traffic signal. Yet another would be to control the lights in a town or a sound system. Optionally Secondary Receive Messages allow two different commands to trigger the same output. An example Secondary Receive Message would allow a simulated (or actual) lamp test by programming in a single Secondary Receive Message address for each panel lamp.

Secondary Messages are in addition to any messages that are normally sent or received, and may be sent to or respond to any address. They may be sent on the same or a different transition of the input line.