

# 2010ECL / 2018ECL / 2018KCL 33X Cabinet Flashing Yellow Arrow Overview



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# Flashing Yellow Arrow

- Need for FYA
  - FHWA issued Interim Approval for use in March of 2006, dropping the experimental status
  - Allows protected-permitted left-turns and lead-lag phasing without the “Yellow Trap”.
  - Extremely flexible allowing protected-only or permitted-only by Time of Day or Queue
  - Has Good Driver Understanding
  - The array of phasing and detection combinations allows the engineer to maximize capacity at an intersection

# Flashing Yellow Arrow Milestones

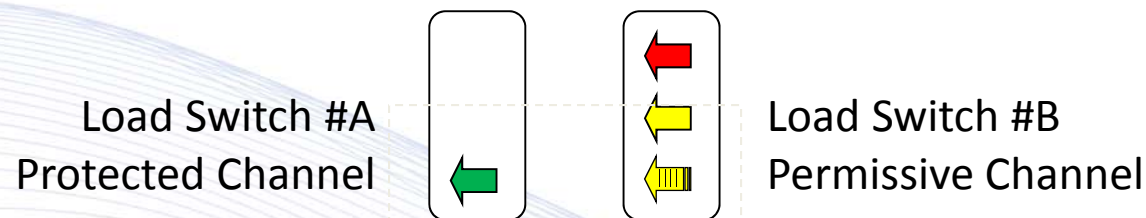
- NCHRP 3-54 Report 2003
- First FYA capable monitor deployed in 2005 by EDI
- MUTCD formal release in 2009
  - Defines Signal operation
- NEMA FYA Amendment #4 November 2012
  - Defines Equipment operation
  - Now NEMA TS2-2016 Standard

# Paired Channel Modes

- The 2010ECL, 2018ECL, and 2018KCL monitor series provides for three modes:
  - FYA standard mode requires no remapping
    - Two load switches and two monitor channels per approach
    - Auxiliary File required to supply channels 9-12
  - FYAC (Compact) mode remaps the Ped Yellow outputs
    - One+ load switch and two monitor channels per approach
    - Requires CU output remapping capability
    - Requires Caltrans Ch 9,10 OLP wiring of Ped Yellows
    - No Aux File needed
  - FYAC Mode-H (Compact) mode uses the Ped Yellow outputs
    - One+ load switch per approach, no *additional* monitor channel needed
    - Requires CU output remapping capability
    - With an Aux File, four channels are freed for overlaps or other movements

# Paired Channels

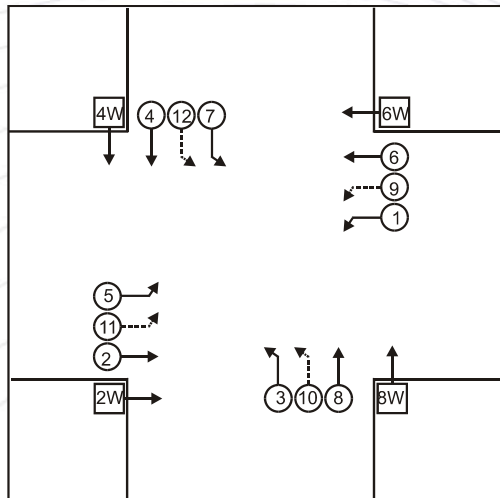
- The monitor uses two paired channels to monitor the four outputs of the FYA Signal Output Group.



- Each FYA approach typically requires two load switches and two monitor channels.
- Unused Yellow output of the Protected channel must be disabled if not used to drive a signal head.
  - Use Yellow Disable jumpers on the Program Card

# FYA Mode

- FYA Mode assigns the Protected turn phases to channels 1, 3, 5, and 7, and the Permissive turn overlap phases to channels 9, 10, 11, and 12.



FYA Mode	Ch: 1		3		5		7		9		12		13		16	
	Protected Turn Channels (Ga)				Opposing Through Channels				Permissive Turn Channels (Ra, Ya, fYa)				Green Arrow Signal Driver Source			
	1				2				9							
	3				4				10							
	5				6				11							
	7				8				12							

- This mode requires the use of an Aux File to populate load switches for channels 9-12.
- No CU IO mapping is required.

# FYA Mode Programming (ECL)

- FYAC switch
  - OFF: Standard FYA mode is selected
- FYA 1, 3, 5, 7 switches
  - ON: enables a channel pair for FYA monitoring functions
- The SSM switch is ON for the Permissive turn channels 9,10,11,12
- The SSM switch is OFF for the Protected turn channels 1,3,5,7
  - If signal loads are not being driven from the Protected Red and Yellow outputs then the SSM switch for the associated protected turn channel 1,3,5,7 should be OFF and the Yellow Disable jumper IS installed.
  - If signal loads are driven from the Protected Red and Yellow outputs (e.g. hardwired right turn overlaps) then the SSM switch for the associated protected turn channel 1,3,5,7 should be ON and the Yellow Disable jumper NOT installed.

Primary Channel	Permissive With:
1	5, 6, 11
2	5, 6, 9, 11
3	7, 8, 12
4	7, 8, 10, 12
5	9
6	9, 11
7	10
8	10, 12
9	11
10	12
11	--
12	--

Note: This example is for illustrative purposes ONLY.  
Permissive Programming for an application depends on actual intersection geometry, cabinet wiring, and Controller programming. Ped channels are not included.

# FYA Mode Programming (KCL)

- FYA Mode (Green Arrow Group 1, 3, 5, 7)
  - ON: Standard FYA mode is selected
- FYA 1, 3, 5, 7 Channel Enable
  - ON: Enables a channel pair for FYA monitoring functions
- Red Fail
  - ENABLED for the Permissive turn channels 9,10,11,12
  - DISABLED for the Protected turn channels 1, 3, 5, 7
- Dual Indication
  - G-R, Y-R, & G-Y ENABLED for the Permissive turn channels 9,10,11,12
  - G-R, Y-R, & G-Y DISABLED for the Protected turn channels 1, 3, 5, 7
- Minimum Yellow Change Clearance
  - ENABLED for the Permissive turn channels 9,10,11,12
  - DISABLED for the Protected turn channels 1, 3, 5, 7
- Minimum Yellow Plus Red Clearance
  - DISABLED for the Permissive turn channels 9,10,11,12
- Yellow Disable
  - Yellows DISABLED for the Protected turn channels 1, 3, 5, 7

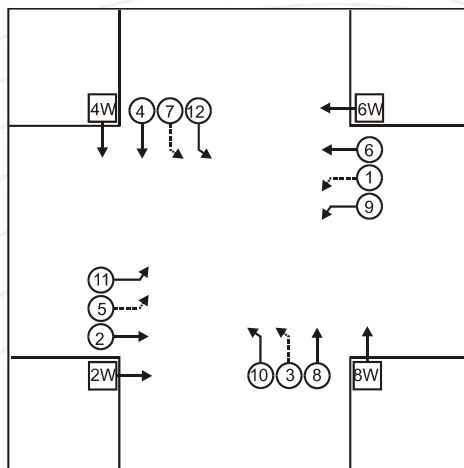
Note: If hardwired Right Turn Overlaps are used then the Protected turn channels 1, 3, 5, 7 should be configured as standard 3-section vehicle channels (Red Fail, Dual Indication, MYR Clearance ENABLED, and Yellows Enabled).



# FYAC (Compact) Mode

- FYAC Mode has the Ped-Y outputs remapped to drive the Protected turn phases.
- FYAC mode would be used when there are not enough load switches, e.g. no Aux File.

FYAC Mode	Ch: 1 3 5 7 9 12 13 16															
	Protected Turn Channels (Ga)				Opposing Through Channels				Permissive Turn Channels (Ra, Ya, fYa)				Green Arrow Signal Driver Source			
	9				2				1				13	Yellow (Ped)		
10				4				3				14	Yellow (Ped)			
11				6				5				15	Yellow (Ped)			
12				8				7				16	Yellow (Ped)			



- This mode provides 8 phases + 4 Peds + 4 FYA with a standard 12 position Output File.
- CU IO mapping is required.
- Caltrans Ped Yellow cabinet wiring is required.

# FYAC Compact Mode Mapping

- The cabinet is wired such that the Ped Yellow load switch outputs are wired to the Signal Monitor inputs as follows:

Phase	Load Switch #	Monitor Physical Input
Ped 2 Yellow	3	Ch 9 Green (pin 13)
Ped 4 Yellow	6	Ch 9 Yellow (pin 16)
Ped 6 Yellow	9	Ch 10 Green (pin R)
Ped 8 Yellow	12	Ch 10 Yellow (pin U)

- The monitor will then remap the physical inputs to monitor channels as follows:

Monitor Physical Input	Monitor Logical Channel	Associated FYA Channel
Ch 9 Green	Ch 9 Green (arrow)	Ch 1 (OLP)
Ch 9 Yellow	Ch 10 Green (arrow)	Ch 3 (OLP)
Ch 10 Green	Ch 11 Green (arrow)	Ch 5 (OLP)
Ch 10 Yellow	Ch 12 Green (arrow)	Ch 7 (OLP)

# FYAC (Compact) Mode

In the Compact mode when the CU serves Phase 7 Protected Left turn, the technician will see:

- The CU will drive Load Switch #12 (Ph 8 Ped) Yellow and illuminate the Yellow indicator on the load switch.
- The Monitor will display Channel 12 Green active, remapped from the channel 10 Yellow input.
- All monitor programming should reference the final Protected Turn assignment of channels 9-12.

# FYAC Mode Programming (ECL)

- FYAC switch
  - ON: FYA Compact mode is selected
- FYAC MODE-H switch
  - OFF: FYA Compact Mode-H is not selected
- FYA 1, 3, 5, 7 switches
  - ON: enables a channel pair for FYA monitoring functions
- The SSM switch is ON for the Permissive turn channels 1,3,5,7
- The SSM switch is OFF for the Protected turn channels 9,10,11,12

Primary Channel	Permissive With
1	2, 5, 6, 11
2	5, 6, 11
3	4, 7, 8, 12
4	7, 8, 12
5	6, 9
6	9
7	8, 10
8	10
9	11
10	12
11	--
12	--

Note: This example is for illustrative purposes ONLY. Permissive Programming for an application depends on actual intersection geometry, cabinet wiring, and Controller programming. Ped channels are not included.

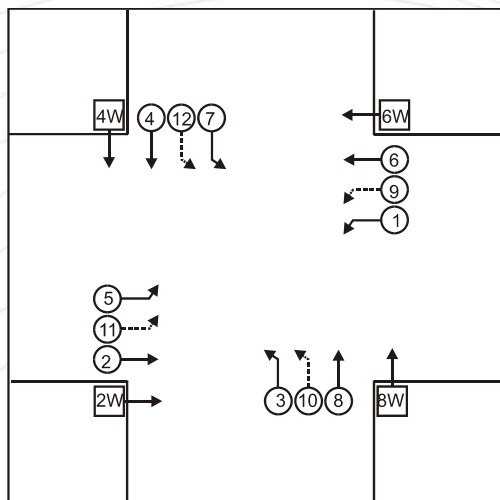
# FYAC Mode Programming (KCL)

- FYAC Mode (Green Arrow Group 9, 10, 11, 12)
  - ON: Compact FYAC mode is selected
- FYA 1-9, 3-10, 5-11, 7-12 Channel Enable
  - ON: Enables a channel pair for FYA monitoring functions
- Red Fail
  - ENABLED for the Permissive turn channels 1, 3, 5, 7
  - DISABLED for the Protected turn channels 9, 10, 11, 12
- Dual Indication
  - G-R, Y-R, & G-Y ENABLED for the Permissive turn channels 1, 3, 5, 7
  - G-R, Y-R, & G-Y DISABLED for the Protected turn channels 9, 10, 11, 12
- Minimum Yellow Change Clearance
  - ENABLED for the Permissive turn channels 1, 3, 5, 7
  - DISABLED for the Protected turn channels 9, 10, 11, 12
- Minimum Yellow Plus Red Clearance
  - DISABLED for the Permissive turn channels 1, 3, 5, 7

# FYAC Mode *Alternate* Mapping

- FYAC Alternate Mapping has the Ped-Y outputs remapped to drive the Permissive turn phases.
- This assignment is used in some brands of CUs. *Not recommended but supported.*

FYAC Mode (ALT)	Ch: 1	3	5	7	9	12	13	16
	Protected Turn Channels (Ra, Ya, Ga)		Opposing Through Channels		Permissive Turn Channels (fYa)		Flashing Yellow Arrow Signal Driver Source	
	1	3	5	7	9	10	11	12
							13 Yellow (Ped)	14 Yellow (Ped)
							15 Yellow (Ped)	16 Yellow (Ped)



- The Flash Rate Detect function **MUST be Disabled.**
- CU IO mapping is required.
- Caltrans Ped Yellow cabinet wiring is required.
- **Start-up in All Yellow is not allowed.**
- **TOD Flash in All Yellow is not allowed.**

# FYAC *Alternate* Mode Programming (ECL)

- FYAC switch
  - **ON**: FYAC mode is selected
- FYA 1-9, 3-10, 5-11, 7-12 switches
  - **ON**: enables a channel pair for FYA monitoring functions
- The SSM switch is **OFF** for the Permissive turn channels 9,10,11,12
- The SSM switch is **ON** for the Protected turn channels 1,3,5,7
- The Flash Rate Detect function is disabled, SEL15 installed

Primary Channel	Permissive With:
1	5, 6, 11
2	5, 6, 9, 11
3	7, 8, 12
4	7, 8, 10, 12
5	9
6	9, 11
7	10
8	10, 12
9	11
10	12
11	--
12	--

Note: This example is for illustrative purposes ONLY.  
Permissive Programming for an application depends on actual intersection geometry, cabinet wiring, and Controller programming. Ped channels are not included.

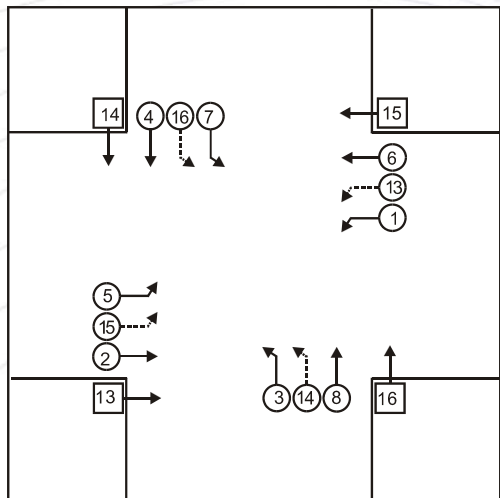
# FYAC *Alternate* Mode Programming (KCL)

- FYAC Mode (Green Arrow Group 9, 10, 11, 12)
  - ON: Compact FYAC mode is selected
- FYA 1-9, 3-10, 5-11, 7-12 Channel Enable
  - ON: Enables a channel pair for FYA monitoring functions
- Red Fail
  - ENABLED for the Protected turn channels 1, 3, 5, 7
  - DISABLED for the Permissive turn channels 9, 10, 11, 12
- Dual Indication
  - G-R, Y-R, & G-Y ENABLED for the Protected turn channels 1, 3, 5, 7
  - G-R, Y-R, & G-Y DISABLED for the Permissive turn channels 9, 10, 11, 12
- Minimum Yellow Change Clearance
  - ENABLED for the Protected turn channels 1, 3, 5, 7
  - DISABLED for the Permissive turn channels 9, 10, 11, 12
- Minimum Yellow Plus Red Clearance
  - DISABLED for the Permissive turn channels 9, 10, 11, 12
- Flash Rate Fault Disable
  - DISABLED (checked)



# FYAC Mode-H (Compact) Mode

- FYAC Mode-H has the Ped-Y outputs remapped to drive the Permissive fYa turn phases.
- FYAC Mode-H would be used when there is an Aux File, so that Ch 9-12 are freed to assign to other movements.



	Ch: 1	3	5	7	9	12	13	16
FYAC Mode-H								
	Protected Turn Channels (Ra, Ya, Ga)		Opposing Through Channels		Permissive Turn Channels (fYa)		Flashing Yellow Arrow Signal Driver Source	
	1	3	5	7	9	13	13	16 Yellow (Ped)
	3	4	6	8	14	14	14	16 Yellow (Ped)
	5	6	15	15	15	15	15	16 Yellow (Ped)
	7	8	16	16	16	16	16	16 Yellow (Ped)

- This mode provides 8 phases + 4 Peds + 4 FYA + 4 OLPs with an Output File & Aux File.
- CU IO mapping is required.
- Ped Yellow cabinet wiring is required.

# FYAC Mode-H (Compact) Mode Mapping

- The cabinet is wired such that the Ped Yellow load switch outputs are wired to the Signal Monitor inputs as follows:

FYAC MODE-H Load Switch Mapping (332 Cabinet)		
Phase	Load Switch #	Monitor Physical Input
Ped 2 Yellow	3	Ch 13 Yellow(pin 8)
Ped 4 Yellow	6	Ch 14 Yellow (pin 11)
Ped 6 Yellow	9	Ch 15 Yellow(pin K)
Ped 8 Yellow	12	Ch 16 Yellow (pin N)

FYAC MODE-H Load Switch Mapping (330 Cabinet)		
Phase	Load Switch #	Monitor Physical Input
Ped 2 Yellow	13	Ch 13 Yellow(pin 8)
Ped 4 Yellow	14	Ch 14 Yellow (pin 11)
Ped 6 Yellow	15	Ch 15 Yellow(pin K)
Ped 8 Yellow	16	Ch 16 Yellow (pin N)

# FYAC Mode-H(Compact) Mode

In Compact Mode-H when the CU serves Phase 4 Permissive Left turn, the technician will see:

- The CU will drive Ph 8 Ped Load Switch (#12) Yellow input and illuminate the Yellow indicator on the load switch (flashing).
- The Monitor will display Channel 16 Yellow active (flashing).

Pro: Channels 9-12 are free to assign to other phases (OLPs, Ped, Veh, etc)

Con: The technician must determine whether a fault condition on channels 13-16 is a result of the fYa or DW/W.

All monitor programming should reference the final Ped / PermissiveTurn assignment of channels 13-16.

# FYAC Mode-H Mode Programming (ECL)

- FYAC switch
  - ON: FYA Compact mode is selected
- FYAC MODE-H switch
  - ON: FYA Compact Mode-H is selected
- FYA 1, 3, 5, 7 switches
  - ON: enables a channel pair for FYA monitoring functions
- The SSM switch is ON for the Protected turn channels 1,3,5,7
- The SSM switch is typically OFF for the Ped channels 13,14,15,16, unless R-G (DW-W) Dual Indication monitoring is desired.

Primary Channel	Permissive With
1	5, 6, 15
2	5, 6, 13, 15
3	7, 8, 16
4	7, 8, 14, 16
5	13
6	13, 15
7	14
8	14, 16
9	--
10	--
11	--
12	--
13	15
14	16
15	--

Note: This example is for illustrative purposes ONLY. Permissive Programming for an application depends on actual intersection geometry, cabinet wiring, and Controller programming. Ped channels are not included.

# FYAC Mode-H Mode Programming (KCL)

- FYAC Mode-H (Green Arrow Group 1,3,5,7)
  - ON: Compact FYAC Mode-H is selected
- FYA 1-13, 3-14, 5-15, 7-16 Channel Enable
  - ON: Enables a channel pair for FYA monitoring functions
- Red Fail
  - ENABLED for the Protected turn channels 1, 3, 5, 7
  - ENABLED for the Pedestrian channels 13, 14, 15, 16 (W & DW only)
- Dual Indication
  - G-R, Y-R, & G-Y ENABLED for the Protected turn channels 1, 3, 5, 7
  - G-R ENABLED for the Pedestrian channels 13, 14, 15, 16 (W & DW only)
- Minimum Yellow Change Clearance
  - ENABLED for the Permissive turn channels 1, 3, 5, 7
  - DISABLED for the Pedestrian channels 13, 14, 15, 16 (DW & W only)
- Minimum Yellow Plus Red Clearance
  - DISABLED for the Permissive turn channels 1, 3, 5, 7
  - ENABLED for the Pedestrian channels 13, 14, 15, 16 (W & DW only)

# FYA Monitoring Functions

- **Dynamic Clearance Conflict Detection**
  - During Permissive clearance interval, the solid Y arrow is compatible with the opposing thru phase.
  - During Protected clearance interval, the solid Y arrow is conflicting with the opposing thru phase.
- **Red Fail**
  - No active signal for Red arrow, Yellow arrow, Flashing Yellow arrow, Green arrow.
- **Dual Indication**
  - Red + Yellow, Red + Green, Red + Flashing Yellow,
  - Green + Yellow, Green + Flashing Yellow
  - Yellow + Flashing Yellow
- **Clearance**
  - Flashing Yellow arrow → solid Yellow arrow → Red arrow
  - Green arrow → solid Yellow arrow → Red arrow
- **Stuck-On flashing Yellow arrow**
  - Disabled with SEL15 jumper

# Flashing Yellow Arrow with the EDI 2010ECL - 2018ECL - 2018KCL

## Setting the Standard for Quality and Reliability

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