MMU2-16LEip FYA Overview
NEMA Flashing Yellow Arrow Standard

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 TS2-2016 Standard
  - Includes FYA Amendment #4 November 2012
  - Defines Equipment operation

NEMA TS-2 FYA Amendment

- Defines both CU and MMU2 operation
  - Devices conformant to the NEMA Standard will be interoperable and interchangeable.
  - An MMU conformant to the NEMA FYA Standard is labeled an “MMU2”.
- Development Cycle
  - Project started in Q1-2009
  - Completed in August 2011
  - Publication in 2012 as NEMA TS2 FYA Amendment #4
  - Publication in 2016 as NEMA TS2-2016
- Compliant to MUTCD 2009
NEMA Controller Section

• NEMA Definitions
  – Four output groups with four output states
  – Uses an Overlap concept to control the permissive phases
• FYA Signal Output Group
  – Red Arrow assigned to Overlap Red
  – Solid Yellow Arrow assigned to Overlap Yellow
  – Flashing Yellow Arrow assigned to Overlap Green
  – Green Arrow assigned to LT Protected movement
• NTCIP object definitions are still needed

NEMA MMU2 Section

• Definitions – “MMU2”
  – Permissive Turn Channel
  – Protected Turn Channel
  – Opposing Through Channel
  – Paired Channels
• The NEMA Standard does not define a method of programming the MMU2.
  – Interchangeability is achieved when MMU2 units are configured to produce the same functional operation.
NEMA MMU2 Paired Channels

- The MMU2 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 MMU channels.
- Unused Red and Yellow outputs of the Protected channel can be disabled.

MMU2 Paired Channel Modes

- The NEMA Standard provides for a minimum of 8 modes.
  - Four modes require no remapping
    - Two load switches and two MMU channels per approach
  - Two modes remap the Ped Yellow outputs
    - One+ load switch and two MMU channels per approach
  - Two alternate modes
    - One+ load switch and one+ MMU channel per approach
- Preconfigured modes simplify the cabinet and MMU2 setup and follow typical phase to channel assignment conventions in use.
- Choose a mode based on cabinet resources and level of remapping to be tolerated.
How to Choose a Mode

Assume each FYA approach needs 2x MMU channels and 2x load switches.

- If the cabinet can provide two MMU channels and two load switches for each FYA approach then use Modes A-D.
  - Simple configuration with No mapping.
- If the cabinet can provide two MMU channels but does not have an additional load switch for each FYA approach then use Modes E-F.
  - For example, a 12 position back panel.
  - CU mapping and MMU mapping required, adds programming and trouble shooting complexity.
  - Monitoring of Pedestrian Yellow Clearance interval for Conflicts is sacrificed.
- If the cabinet does not have any additional MMU channels or load switches then use Modes G-H.
  - For example, 4 thru + 4 Ped + 4 OLPs + 4 FYA.
  - CU mapping required, adds programming and trouble shooting complexity.
  - Restricts FYA permissive programming to be the same as the parent Ped phase programming.
  - MMU display combines the flashing Yellow Arrow icon with the Ped Walk and Don’t Walk icons.
  - Monitoring of Pedestrian Yellow Clearance interval for Conflicts is sacrificed.

Modes A-B (No Mapping)

- Modes A and B assign the Protected turn phases to channels 1, 3, 5, and 7, and the Permissive turn overlap phases to either channels 9-12 or 13-16.
- This accommodates cabinets that have pedestrian phases assigned to either channel group; 9-12 or 13-16
Modes C-D (No Mapping)

- Modes C and D assign the Protected turn phases to either channels 9-12 or 13-16. Channels 1, 3, 5, and 7, are the Permissive turn overlap phases.

- This accommodates cabinets that have pedestrian phases assigned to either channel group, 9-12 or 13-16.

Modes E-F (Ped-Y Mapping)

- Modes E and F have the Ped-Y outputs remapped to drive the Protected turn phases.
  - Mapping adds a level of difficulty to trouble shoot.

- Modes E and F would be used when there are not enough load switches provided in the back panel.
Modes I-J (Ped-Y Mapping)

- Modes I and J have the Ped-Y outputs remapped to drive the Permissive turn phases.
  - Mapping adds a level of difficulty to troubleshoot.
- Modes I and J would be used when there are not enough load switches provided in the back panel.
- Retrofit would be easier.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Channels (Ra, Ya, Ga)</th>
<th>Opposing Through Channels</th>
<th>Through Channels (fYa)</th>
<th>Permissive Turn Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1 2 9 13</td>
<td>3 4 10 14</td>
<td>Yellow (Ped)</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>1 2 13</td>
<td>3 4 10 14</td>
<td>Yellow (Ped)</td>
<td></td>
</tr>
</tbody>
</table>

Modes G-H (Alternate, Mapping)

- Modes G and H have the Ped-Y outputs remapped to drive the Permissive turn phases.
  - Permissive turn channels assume compatibility programming and display of the associated Ped phases.
  - Startup in Yellow or TOD Flash in Yellow is not supported.
- Modes G and H are used when there are not enough load switches and/or channels provided.
  - Simplify retrofits & use only one MMU channel per pair.
  - Leaves four channels available for normal overlap uses. For example, 4 thru + 4 ped + 4 OLPs + 4 FYA.

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<th>Opposing Through Channels</th>
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<th>Permissive Turn Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>1 2 9 13</td>
<td>3 4 10 14</td>
<td>Yellow (Ped)</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>1 2 13</td>
<td>3 4 10 14</td>
<td>Yellow (Ped)</td>
<td></td>
</tr>
</tbody>
</table>
Modes K-L (Alternate, No Mapping)

- Modes K and L assign the Permissive turn phases to either channels 9-12 or 13-16. Channels 1, 3, 5, and 7, are the Protected turn phases.

- Retrofits would be easier, but this assignment does not follow the NEMA overlap definition.

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<table>
<thead>
<tr>
<th>Mode</th>
<th>Protected Turn Channels (Ra, Ya, Ga)</th>
<th>Opposing Through Channels</th>
<th>Permissive Turn Channels (fYa)</th>
<th>Flashing Yellow Arrow Signal Driver Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>1 2 9</td>
<td>1 4 10</td>
<td></td>
<td>9 Green</td>
</tr>
<tr>
<td>L</td>
<td>1 2 13</td>
<td>1 4 14</td>
<td></td>
<td>13 Green</td>
</tr>
</tbody>
</table>
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Additional FYA 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.
- Flashing Yellow output is monitored for a stuck-on malfunction.
- Protected channel R and Y inputs can be disabled if not utilized.
MMU2-16LEip FYA Programming

First step is to select the Mode, A-L.

For each mode selected the display will show the channel assignments.

For Type 12 operation only modes A, C, G, and K are provided.

Second step is to Enable a channel pair for each approach.

For each pair enabled the display will show the channel assignments.
MMU2-16LEip FYA Programming

Third step is to Enable the use of the Red and Yellow input of the sparse channel (G only) if needed.

Typically, the R&Y input is disabled, and the MMU will ignore any voltage on the inputs and set them to Off. This eliminates the need to use a dummy resistor on the unused Red and Yellow load switch outputs.

MMU2-16LEip FYA Programming

Final step is to select the FYA Options.

The FlashRate Fault option will set a fault if the flashing Yellow Arrow stops flashing.

The FYA Trap Detect option will set a fault if the permissive turn channel (FYa) clears to solid Yellow while the opposing thru phase is Green.
EDI FYA Product Plans

- NEMA published the FYA Standard in November 2012.
- NEMA FYA functionality will be released as the MMU2-16LE(ip) product.
  - The MMU2-16LE(ip) is functionally the same as the MMU-16LE(ip) but includes the NEMA FYA compliant operation.
  - The MMU-16LE(ip) product line is discontinued. It provided only the basic FYA and FYAc modes of operation.
- The EDI MMU2-16LEip SmartMonitor will provide an additional four FYA modes beyond the NEMA standard for a total of 12 modes.

FAQ

- What is the difference between the MMU2-16LE(ip) and the MMU-16LE(ip)?
  - The units are functionally the same except for the FYA operation. The MMU2-16LE complies with the new NEMA standard.
  - NEMA Mode B is equivalent to the MMU-16LE “FYA” mode.
  - NEMA Mode F is equivalent to the MMU-16LE “FYAC” compact mode.
- Is there any price difference?
  - No.
- Can EDI update the MMU-16LE firmware to the MMU2-16LE?
  - Yes
- Can a user reflash the MMU-16LE with MMU2-16LE firmware?
  - Yes, consult the factory for details and firmware files.
- If an MMU-16LE is returned for factory repair and needs a firmware update, will it be automatically updated to MMU2-16LE level?
  - Yes, it will be changed to MMU2-16LE firmware with a label indicating the update.
Advances in Signal Monitoring

- Be aware of new technology advancements.
- Keep equipment specifications up to date.
  - You are likely not using the same cell phone or TV that you used even 5 years ago.
- Technicians must learn to be more productive and more effective to keep up.
- New applications such as Flashing Yellow Arrow provide opportunities to move more vehicles and in a safer manner.

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MMU2-16LE FYA Overview
NEMA Flashing Yellow Arrow Standard

Setting the Standard for Quality and Reliability

Eberle Design Inc.
www.EDItraffic.com