



Commissioning guide

Dynec⁺ with Unidrive M700, M701, M702 without position feedback

*Motors 11 to 240 kW
interchangeable version
1,500 and 3,000 series
with drive*

Reference: 6069 en - 2022.06 / c

LEROY-SOMERTM

1 - INTRODUCTION

Before setting up the drive, please follow the safety and installation instructions for Dyneo+ motors and Unidrive M70x drives described in their respective manuals.

Dyneo+ motors:

http://www.leroy-somer.com/documentation_pdf/5411_en.pdf

Unidrive M70x drive:

See the Getting Started Guide and associated Power Installation Guide (available from the Control Techniques website).



- **The installation and commissioning must be carried out by qualified, competent and authorised personnel.**

Then proceed with the quick commissioning described in 2 from the factory setting.

Requirements:

- Ensure the drive has a firmware version equal or higher than V01.20.00.00.
- Do not enable the autotune procedure.
- Parameters shown in motor data tables from the annex are only applicable for the Unidrive M70x drive rating indicated for each data line. If a drive with a different rating is used, then Current Controller Kp Gain (**Pr 04.013**) and Current Controller Ki Gain (**Pr 04.014**) must be scaled as detailed below:

$$\text{New value} = \text{Annex value} \times (\text{KC New drive} / \text{KC Annex drive})$$

Values for KC can be found in the Parameter Reference Guide, in the Current Ratings section or in the online help of Control Techniques Connect Software.

2 - COMMISSIONING WITH UNIDRIVE M70x WITHOUT POSITION FEEDBACK

RFC-S mode for interchangeable Dyneo⁺ permanent magnet motors without position feedback (sensorless)

Action	Description
Before power-up	Ensure: • The drive enable signal is not given (terminal 31 on Unidrive M700/M701 and terminals 11 & 13 on Unidrive M702) • The Run signal is not given • Motor is connected
Power-up the drive	If Open Loop or RFC-A mode is displayed when the drive is powered up: • Set Pr 00.048 = RFC-S (3). • If the frequency of the mains supply is 60Hz, set Pr 00.000 = 1254, otherwise if the frequency of the mains is 50Hz, set Pr 00.000 = 1253. If RFC-S mode is displayed when the drive is powered up: • If the frequency of the mains supply is 60Hz, set Pr 00.000 = 1244, otherwise if the frequency of the mains is 50Hz, set Pr 00.000 = 1233. Press the red Reset button or toggle the Reset logic input. These actions will leave the drive in RFC-S mode with defaulted parameters. The drive will be in a tripped state, but the associated trips are addressed by settings within this procedure.
Advanced menu access from the keypad	To access all menus required for commissioning, set Pr 00.0049 = All Menus (1). Reminder: Select the menus using the left and right arrows. The parameters are selected using the up and down arrows.
Set maximum speed	Set the maximum speed in Pr 01.006 (rpm).
Set acceleration and deceleration rates	Set: • Acceleration rate in Pr 02.011 (s up to Pr 01.006) - A value of 20s suites most applications. • Deceleration rate in Pr 02.021 (s up to Pr 01.006) - A value of 20s suites most applications. • Ramp Rate Units Pr 02.039 = On (1) If a braking resistor is installed, set Pr 02.004 = Fast (0). Also ensure Pr 10.030, Pr 10.031 and Pr 10.061 are set correctly, otherwise premature 'Brake R Too Hot' trips may be seen.
Motor thermistor set-up	The motor PTC thermistor must be connected to the drive: • M700/M701: Connect thermistor to analogue input 3 (terminals 8 and 11). • M702 (with date code 1710 or later): Connect thermistor to digital input 5 / analogue input 3 (terminals 8 and 10). For the drive to manage the thermistor: • Set Analogue Input 3 Mode Pr 07.015 = Therm short Cct (7). If connection of the thermistor leaves insufficient inputs, then it may be necessary to fit an SI-I/O module.

Action	Description																																																																																																																																																																									
Enter motor nameplate details	Refer to the Dyneo+ motors tables located in the Appendix. Select the table corresponding to the motor speed range (1500 or 3000 rpm). Then depending on the motor type and its power, select the line that corresponds to the voltage, the supply frequency and the rated speed of the application. From this line, set in the drive the values of all the parameters listed in the table. If the load is a high inertia, Pr 03.010 may need to be increased.																																																																																																																																																																									
	NOTE : If the motor type does not appear in the table, then it is from the Compact range. In this case, please contact Control Techniques Technical Support.																																																																																																																																																																									
	Example: For the 1500 range motor, LSHRM 160MR1 - 11 kW 400V - 50Hz with a rated speed of 1500 rpm, parameter values to set in the drive are the ones of the green line as indicated below:																																																																																																																																																																									
	<table><tr><th colspan="23">GAMME 1500 min⁻¹</th></tr><tr><th rowspan="3">Type MOTEUR</th><th rowspan="3">kW</th><th colspan="2">VARIATEUR</th><th rowspan="3">Couplage</th><th rowspan="3">Hz</th><th colspan="17">PARAMETRES</th></tr><tr><th rowspan="2">M700</th><th colspan="16"></th></tr><tr><th>#03.010 Gain Vitesse Kp</th><th>#03.011 Gain Vitesse Ki</th><th>#04.013 Gain Courant Kp</th><th>#04.014 Gain Courant Ki</th><th>#04.015 Constante thermique (s)</th><th>#05.007 Courant nominal (A)</th><th>#05.008 Vitesse (min⁻¹)</th><th>#05.009 Tension (V)</th><th>#05.017 Resistance Stator (Ω)</th><th>#05.024 Ld (mH)</th><th>#05.033 BEMF (V/ kmin⁻¹)</th><th>#05.069 Courant de défaut (%)</th><th>#05.072 Lq @0A (mH)</th><th>#05.075 Iq (%)</th><th>#05.078 Lq @ Iq (mH)</th><th>#05.082 Id (%)</th><th>#05.084 Lq @ Id (mH)</th><th>#05.087 Angle de couple (°)</th></tr><tr><td rowspan="4">LSHRM 160 MR1</td><td>11</td><td>44-00172</td><td>Y</td><td>50</td><td>0.005</td><td>0.05</td><td>152</td><td>269</td><td>800</td><td>21.0</td><td>1500</td><td>400</td><td>0.31582</td><td>7.626</td><td>72.1</td><td>236</td><td>68.540</td><td>73</td><td>44.845</td><td>-108</td><td>68.540</td><td>56</td></tr><tr><td>11</td><td>44-00172</td><td>Y</td><td>60</td><td>0.005</td><td>0.05</td><td>152</td><td>269</td><td>800</td><td>20.3</td><td>1800</td><td>400</td><td>0.31582</td><td>7.626</td><td>72.1</td><td>244</td><td>68.540</td><td>73</td><td>44.845</td><td>-108</td><td>68.540</td><td>56</td></tr><tr><td>12.7</td><td>44-00172</td><td>Y</td><td>60</td><td>0.005</td><td>0.05</td><td>152</td><td>269</td><td>800</td><td>21.2</td><td>1800</td><td>460</td><td>0.31582</td><td>7.626</td><td>72.1</td><td>233</td><td>68.540</td><td>73</td><td>44.845</td><td>-108</td><td>68.540</td><td>56</td></tr><tr><td>19.1</td><td>64-00420</td><td>D</td><td>87</td><td>0.005</td><td>0.05</td><td>124</td><td>219</td><td>800</td><td>38.2</td><td>2600</td><td>400</td><td>0.10527</td><td>2.542</td><td>41.6</td><td>218</td><td>22.847</td><td>73</td><td>14.948</td><td>-108</td><td>22.850</td><td>56</td></tr></table>	GAMME 1500 min ⁻¹																							Type MOTEUR	kW	VARIATEUR		Couplage	Hz	PARAMETRES																	M700																	#03.010 Gain Vitesse Kp	#03.011 Gain Vitesse Ki	#04.013 Gain Courant Kp	#04.014 Gain Courant Ki	#04.015 Constante thermique (s)	#05.007 Courant nominal (A)	#05.008 Vitesse (min ⁻¹)	#05.009 Tension (V)	#05.017 Resistance Stator (Ω)	#05.024 Ld (mH)	#05.033 BEMF (V/ kmin ⁻¹)	#05.069 Courant de défaut (%)	#05.072 Lq @0A (mH)	#05.075 Iq (%)	#05.078 Lq @ Iq (mH)	#05.082 Id (%)	#05.084 Lq @ Id (mH)	#05.087 Angle de couple (°)	LSHRM 160 MR1	11	44-00172	Y	50	0.005	0.05	152	269	800	21.0	1500	400	0.31582	7.626	72.1	236	68.540	73	44.845	-108	68.540	56	11	44-00172	Y	60	0.005	0.05	152	269	800	20.3	1800	400	0.31582	7.626	72.1	244	68.540	73	44.845	-108	68.540	56	12.7	44-00172	Y	60	0.005	0.05	152	269	800	21.2	1800	460	0.31582	7.626	72.1	233	68.540	73	44.845	-108	68.540	56	19.1	64-00420	D	87	0.005	0.05	124	219	800	38.2	2600	400	0.10527	2.542	41.6	218	22.847	73	14.948	-108	22.850
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	NOTE: When setting Pr 05.069 , it may be necessary to increase the value entered, to ensure that the actual trip level displayed in Pr 05.068 is close to (but not greater than) the required value.																																																																																																																																																																									
Additional settings	Set : • RFC Feedback Mode (Pr 03.024) = Sensorless • P1 Error Detection Level (Pr 03.040) = 0 • P1 Thermistor Fault Detection (Pr 03.123) = None (0) • Motoring Current Limit (Pr 04.005) = 120% max • Regenerating Current Limit (Pr 04.006) = 120% max • Symmetrical Current Limit (Pr 04.007) = 120% max • Current Reference Filter 1 Time Constant (Pr 04.012) = 1 ms [May need to increase this value to counteract ripple from low resolution estimated feedback] • Thermal Protection Mode (Pr 04.016) = Disabled (4) • User Current Maximum Scaling (Pr 04.024) = 120% max • Number of motor pole pairs (Pr 05.011) = 2 • Maximum Switching Frequency (Pr 05.018) = 3kHz (1) • Enable High Speed Mode (Pr 05.022) = Enable (2) • Flux Control Gain (Pr 05.027) = 0.1 • Minimum Switching Frequency (Pr 05.038) = 3kHz (1) • Voltage Headroom Pr 05.041 = 5%. [Do not set a lower value. Increase this value to 10%, if the motor is unstable in the field weakening area] • RFC Low Speed Mode (Pr 05.064) = Injection • Saliency Torque Control Select Pr 05.065 = Auto (3) [Ensure that Pr 05.066 = High (2) otherwise check the value entered for Pr 05.087 from the table] • Inverted Saturation Characteristic (Pr 05.070) = On (1) • Low Speed Sensorless Mode Current (Pr 05.071) = 60% [Note: This forces a reduced current limit between zero speed and 20% of motor rated speed] • Stop Mode (Pr 06.001) = Ramp (1) • Hold Zero Speed (Pr 06.008) = Disabled (0)																																																																																																																																																																									
Save parameters	Select «Save Parameters» in Pr mm.000 and press the red reset button or toggle the reset digital input.																																																																																																																																																																									
Start-up	Drive is ready to start-up.																																																																																																																																																																									

APPENDIX

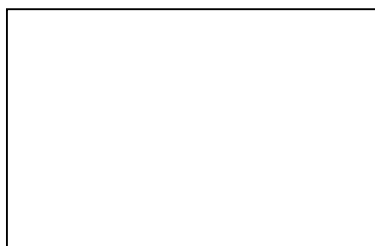
1500 rpm RANGE																						
MOTOR Type	kW	DRIVE		Coupling	Hz	PARAMETERS																
		#03.010	#03.011			#04.013	#04.014	#04.015	#05.007	#05.008	#05.009	#05.017	#05.024	#05.033	#05.069	#05.072	#05.075	#05.078	#05.082	#05.084	#05.087	
		Speed Gain Kp	Speed Gain Ki			Current Gain Kp	Current Gain Ki	Thermal constant (s)	Rated current (A)	Rated speed (rpm)	Rated voltage (V)	Stator Resistance (Ω)	Ld (mH)	BEMF (V/krpm)	Over- current trip level (%)	Lq @0A (mH)	Iq (%)	Lq @ Iq (mH)	Id (%)	Lq @ Id (mH)	Torque Angle (°)	
LSHRM 160 MR1	11	44-00172	Y	50	0.005	0.05	152	269	800	21.0	1500	400	0.31582	7.626	72.1	236	68.540	73	44.845	-108	68.540	56
	11	44-00172	Y	60	0.005	0.05	152	269	800	20.3	1800	400	0.31582	7.626	72.1	244	68.540	73	44.845	-108	68.540	56
	12.7	44-00172	Y	60	0.005	0.05	152	269	800	21.2	1800	460	0.31582	7.626	72.1	233	68.540	73	44.845	-108	68.540	56
	19.1	64-00420	D	87	0.005	0.05	124	219	800	38.2	2600	400	0.10527	2.542	41.6	218	22.847	73	14.948	-108	22.850	56
LSHRM 160 LR1	15	54-00300	Y	50	0.005	0.05	304	493	800	27.5	1500	400	0.28454	7.478	78.7	199	67.889	69	40.485	-110	67.890	58
	15	54-00270	Y	60	0.005	0.05	234	381	800	26.8	1800	400	0.28454	7.478	78.7	204	67.889	69	40.485	-110	67.890	58
	17.3	54-00270	Y	60	0.005	0.05	234	381	800	26.7	1800	460	0.28454	7.478	78.7	204	67.889	69	40.485	-110	67.890	58
	26.0	64-00470	D	87	0.005	0.05	136	221	800	48.6	2600	400	0.09485	2.493	45.4	189	22.630	69	13.495	-110	22.630	58
LSHRM 180 M1	18.5	64-00420	Y	50	0.03	0.1	277	444	1000	35.9	1500	400	0.2133	5.676	73.1	181	43.301	71	31.534	-109	43.300	57
	18.5	64-00420	Y	60	0.03	0.1	277	444	1000	35.1	1800	400	0.2133	5.676	73.1	185	43.301	71	31.534	-109	43.300	57
	21.3	64-00420	Y	60	0.03	0.1	277	444	1000	35.5	1800	460	0.2133	5.676	73.1	183	43.301	71	31.534	-109	43.300	57
	32.1	74-00660	D	87	0.03	0.1	145	232	1000	62.9	2600	400	0.0711	1.892	42.2	174	14.434	71	10.511	-109	14.430	57
LSHRM 180 L1	22	64-00420	Y	50	0.03	0.1	207	281	1000	42.2	1500	400	0.13516	4.253	71.6	196	33.058	73	25.019	-108	33.060	56
	22	64-00420	Y	60	0.03	0.1	207	281	1000	40.1	1800	400	0.13516	4.253	71.6	207	33.058	73	25.019	-108	33.060	56
	25.4	64-00420	Y	60	0.03	0.1	207	281	1000	41.1	1800	460	0.13516	4.253	71.6	202	33.058	73	25.019	-108	33.060	56
	38.1	74-00770	D	87	0.03	0.1	127	172	1000	73.5	2600	400	0.04505	1.418	41.3	189	11.019	73	8.340	-108	11.020	56
LSHRM 200 LQ1	30	64-00470	Y	50	0.03	0.1	190	252	1000	57.0	1500	400	0.10831	3.492	71.6	174	27.497	69	19.675	-110	27.500	58
	30	64-00470	Y	60	0.03	0.1	190	252	1000	54.9	1800	400	0.10831	3.492	71.6	181	27.497	69	19.675	-110	27.500	58
	34.6	64-00470	Y	60	0.03	0.1	190	252	1000	56.1	1800	460	0.10831	3.492	71.6	177	27.497	69	19.675	-110	27.500	58
	52	74-01000	D	87	0.03	0.1	135	179	1000	99.3	2600	400	0.03611	1.164	41.3	168	9.166	69	6.558	-110	9.170	58
LSHRM 225 SZ1	37	74-00660	Y	50	0.03	0.1	232	290	1000	70.1	1500	400	0.08873	3.028	72.3	164	24.063	69	16.697	-110	24.060	58
	37	74-00660	Y	60	0.03	0.1	232	290	1000	68.4	1800	400	0.08873	3.028	72.3	168	24.063	69	16.697	-110	24.060	58
	42.7	74-00660	Y	60	0.03	0.1	232	290	1000	69.2	1800	460	0.08873	3.028	72.3	166	24.063	69	16.697	-110	24.060	58
	64.2	84-01340	D	87	0.03	0.1	157	196	1000	122	2600	400	0.02958	1.009	41.8	157	8.021	69	5.566	-110	8.020	58
LSHRM 225 MG	45	74-00770	Y	50	0.005	0.1	220	172	1200	82.1	1500	400	0.04505	2.467	76.6	201	23.645	67	13.172	-111	23.640	59
	45	74-00770	Y	60	0.005	0.1	220	172	1200	79.6	1800	400	0.04505	2.467	76.6	207	23.645	67	13.172	-111	23.640	59
	54.3	74-00770	Y	60	0.005	0.1	220	172	1200	83.1	1800	460	0.04505	2.467	76.6	198	23.645	67	13.172	-111	23.640	59
	79.2	84-01570	D	87	0.005	0.1	150	117	1200	142	2600	400	0.01502	0.822	44.2	195	7.882	67	4.391	-111	7.880	59
LSHRM 250 ME	55	74-01000	Y	50	0.005	0.1	234	168	1200	99.4	1500	400	0.03388	2.015	76.6	199	19.664	67	10.923	-111	19.660	59
	55	74-01000	Y	60	0.005	0.1	234	168	1200	94.7	1800	400	0.03388	2.015	76.6	208	19.664	67	10.923	-111	19.660	59
	64	74-01000	Y	60	0.005	0.1	234	168	1200	97.8	1800	460	0.03388	2.015	76.6	202	19.664	67	10.923	-111	19.660	59
	95	94-02000	D	87	0.005	0.1	136	98	1200	176	2600	400	0.01129	0.672	44.2	189	6.555	67	3.641	-111	6.550	59
LSHRM 280 SD	75	84-01340	Y	50	0.005	0.1	261	163	1200	134	1500	400	0.02461	1.677	81.7	185	16.736	63	8.988	-114	16.740	61
	75	84-01340	Y	60	0.005	0.1	261	163	1200	130	1800	400	0.02461	1.677	81.7	190	16.736	63	8.988	-114	16.740	61
	86.4	84-01340	Y	60	0.005	0.1	261	163	1200	131	1800	460	0.02461	1.677	81.7	189	16.736	63	8.988	-114	16.740	61
	131	94-02240	D	87	0.005	0.1	127	159	1200	231	2600	400	0.00821	0.559	47.2	180	5.579	63	2.996	-114	5.580	61
LSHRM 280 MD	90	84-01570	Y	50	0.005	0.1	261	154	1200	163	1500	400	0.01982	1.432	80.4	174	14.403	63	7.519	-114	14.400	61
	90	84-01570	Y	60	0.005	0.1	261	154	1200	158	1800	400	0.01982	1.432	80.4	179	14.403	63	7.519	-114	14.400	61
	104	84-01570	Y	60	0.005	0.1	261	154	1200	155	1800	460	0.01982	1.432	80.4	182	14.403	63	7.519	-114	14.400	61
	156	104-02700	D	87	0.005	0.1	149	177	1200	279	2600	400	0.00661	0.477	46.4	171	4.801	63	2.506	-114	4.800	61
LSHRM 315 SN1	110	94-02000	Y	50	0.005	0.1	236	133	1200	199	1500	400	0.01534	1.161	76.6	165	11.750	61	6.646	-115	11.750	62
	110	94-02000	Y	60	0.005	0.1	236	133	1200	195	1800	400	0.01534	1.161	76.6	168	11.750	61	6.646	-115	11.750	62
	132	94-02240	Y	60	0.005	0.1	264	149	1200	202	1800	460	0.01534	1.161	76.6	163	11.750	61	6.646	-115	11.750	62
	192	114-04170	D	87	0.005	0.1	164	185	1200	342	2600	400	0.00511	0.387	44.2	161	3.917	61	2.215	-115	3.920	62
LSHRM 315 MP	132	94-02240	Y	50	0.005	0.1	240	92	1400	235	1500	400	0.00952	1.057	86	194	9.591	59	5.620	-116	9.590	63
	132	94-02240	Y	60	0.005	0.1	240	92	1400	234	1800	400	0.00952	1.057	86	195	9.591	59	5.620	-116	9.590	63
	152	94-02240	Y	60	0.005	0.1	240	92	1400	233	1800	460	0.00952	1.057	86	196	9.591	59	5.620	-116	9.590	63
	229	114-04170	D	87	0.005	0.1	149	115	1400	415	2600	400	0.00317	0.352	49.6	186	3.197	59	1.873	-116	3.200	63
LSHRM 315 MP	160	104-03770	Y	50	0.005	0.1	264	96	1400	304	1500	400	0.00604	0.712	75.2</							

APPENDIX

3000 rpm RANGE																						
MOTOR Type	kW	DRIVE	Coupling	Hz	PARAMETERS																	
		#03.010			#03.011	#04.013	#04.014	#04.015	#05.007	#05.008	#05.009	#05.017	#05.024	#05.033	#05.069	#05.072	#05.075	#05.078	#05.082	#05.084	#05.087	
		Speed Gain Kp			Speed Gain Ki	Current Gain Kp	Current Gain Ki	Thermal constant (s)	Rated current (A)	Rated speed (rpm)	Rated voltage (V)	Stator Resistance (Ω)	Ld (mH)	BEMF (V/krpm)	Over- current trip level (%)	Lq @0A (mH)	Iq (%)	Lq @ Iq (mH)	Id (%)	Lq @ Id (mH)	Torque Angle (°)	
LSHRM 160 MR1	11	44-00172	Y	100	0.005	0.05	95	213	800	20.3	3000	400	0.25015	4.781	43.3	238	41.329	73	27.751	-108	41.329	56
	11	44-00172	Y	120	0.005	0.05	95	213	800	19.8	3600	400	0.25015	4.781	43.3	244	41.329	73	27.751	-108	41.329	56
	12.7	44-00172	Y	120	0.005	0.05	95	213	800	19.9	3600	460	0.25015	4.781	43.3	243	41.329	73	27.751	-108	41.329	56
	19.1	64-00420	D	173	0.005	0.05	78	173	800	35.8	5200	400	0.08338	1.594	25	223	13.776	73	9.25	-108	13.776	56
LSHRM 160 MR1	15	54-00300	Y	100	0.005	0.05	117	223	800	27.7	3000	400	0.12877	2.884	39.3	254	25.538	75	17.72	-106	25.538	55
	15	54-00270	Y	120	0.005	0.05	90	172	800	27.1	3600	400	0.12877	2.884	39.3	259	25.538	75	17.72	-106	25.538	55
	17.3	64-00350	Y	120	0.005	0.05	117	223	800	28.2	3600	460	0.12877	2.884	39.3	249	25.538	75	17.72	-106	25.538	55
	26.0	64-00470	D	173	0.005	0.05	52	100	800	50.9	5200	400	0.04292	0.961	22.7	226	8.513	75	5.907	-106	8.513	55
LSHRM 160 LR1	18.5	64-00350	Y	100	0.005	0.05	117	223	800	33.7	3000	400	0.12877	2.884	39.3	209	25.538	71	17.009	-109	25.538	57
	18.5	64-00350	Y	120	0.005	0.05	117	223	800	32.9	3600	400	0.12877	2.884	39.3	214	25.538	71	17.009	-109	25.538	57
	21.3	64-00350	Y	120	0.005	0.05	117	223	800	33.1	3600	460	0.12877	2.884	39.3	212	25.538	71	17.009	-109	25.538	57
	32.1	74-00660	D	173	0.005	0.05	74	140	800	61.8	5200	400	0.0429	0.961	22.7	186	8.513	71	5.70	-109	8.513	57
LSHRM 180 M1	22	64-00420	Y	100	0.03	0.1	104	192	800	41.8	3000	400	0.0925	2.134	38.2	216	15.79	76	12.578	-105	15.79	54
	22	64-00420	Y	120	0.03	0.1	104	192	800	40.2	3600	400	0.0925	2.134	38.2	224	15.79	76	12.578	-105	15.79	54
	25.5	64-00420	Y	120	0.03	0.1	104	192	800	41.4	3600	460	0.0925	2.134	38.2	218	15.79	76	12.578	-105	15.79	54
	38.1	74-00770	D	173	0.03	0.1	64	118	800	73.6	5200	400	0.0308	0.711	22	200	5.263	76	4.20	-105	5.263	54
LSHRM 200 LQ1	30	64-00470	Y	100	0.03	0.1	116	215	800	56.7	3000	400	0.0925	2.134	38.2	159	15.79	69	11.032	-110	15.79	58
	30	64-00470	Y	120	0.03	0.1	116	215	800	57.1	3600	400	0.0925	2.134	38.2	158	15.79	69	11.032	-110	15.79	58
	34.7	64-00470	Y	120	0.03	0.1	116	215	800	56.5	3600	460	0.0925	2.134	38.2	160	15.79	69	11.032	-110	15.79	58
	37	74-00660	Y	100	0.03	0.1	109	174	800	69.9	3000	400	0.05333	1.419	36.6	178	10.825	71	7.982	-109	10.825	57
LSHRM 200 LQ1	37	74-00660	Y	120	0.03	0.1	109	174	800	68.8	3600	400	0.05333	1.419	36.6	181	10.825	71	7.982	-109	10.825	57
	42.9	74-00660	Y	120	0.03	0.1	109	174	800	69	3600	460	0.05333	1.419	36.6	181	10.825	71	7.982	-109	10.825	57
	45	74-00770	Y	100	0.03	0.1	106	142	800	84.1	3000	400	0.03715	1.185	37.8	180	9.208	71	6.802	-109	9.208	57
	45	74-00770	Y	120	0.03	0.1	106	142	800	82	3600	400	0.03715	1.185	37.8	184	9.208	71	6.802	-109	9.208	57
LSHRM 225 MY1	52	74-00770	Y	120	0.03	0.1	106	142	800	83.4	3600	460	0.03715	1.185	37.8	181	9.208	71	6.802	-109	9.208	57
	55	74-01000	Y	100	0.005	0.1	118	104	1100	100	3000	400	0.02106	1.019	43.4	226	9.52	71	5.657	-109	9.52	57
	55	74-01000	Y	120	0.005	0.1	118	104	1100	101	3600	400	0.02106	1.019	43.4	225	9.52	71	5.657	-109	9.52	57
	63.7	74-01000	Y	120	0.005	0.1	118	104	1100	100	3600	460	0.02106	1.019	43.4	226	9.52	71	5.657	-109	9.52	57
LSHRM 280 SC	75	84-01340	Y	100	0.005	0.1	123	109	1100	138	3000	400	0.01637	0.794	38.3	185	7.412	65	4.063	-113	7.412	60
	75	84-01340	Y	120	0.005	0.1	123	109	1100	136	3600	400	0.01637	0.794	38.3	187	7.412	65	4.063	-113	7.412	60
	86.3	84-01340	Y	120	0.005	0.1	123	109	1100	135	3600	460	0.01637	0.794	38.3	189	7.412	65	4.063	-113	7.412	60
	90	84-01570	Y	100	0.005	0.1	112	88	1100	167	3000	400	0.01125	0.617	38.3	190	5.911	65	3.648	-113	5.911	60
LSHRM 280 MC	90	84-01570	Y	120	0.005	0.1	112	88	1100	160	3600	400	0.01125	0.617	38.3	198	5.911	65	3.648	-113	5.911	60
	104	94-02000	Y	120	0.005	0.1	125	98	1100	168	3600	460	0.01125	0.617	38.3	189	5.911	65	3.648	-113	5.911	60
	110	94-02000	Y	100	0.005	0.1	102	72	1100	201	3000	400	0.00836	0.504	38.3	189	4.916	69	2.56	-110	4.916	58
	110	94-02000	Y	120	0.005	0.1	102	72	1100	195	3600	400	0.00836	0.504	38.3	195	4.916	69	2.56	-110	4.916	58
LSHRM 315 SN1	127	94-02000	Y	120	0.005	0.1	102	72	1100	197	3600	460	0.00836	0.504	38.3	193	4.916	69	2.56	-110	4.916	58
	132	94-02240	Y	100	0.005	0.1	107	70	1100	237	3000	400	0.00722	0.469	40.2	178	4.639	69	2.28	-110	4.639	58
	132	94-02240	Y	120	0.005	0.1	107	70	1100	234	3600	400	0.00722	0.469	40.2	181	4.639	69	2.28	-110	4.639	58
	152	94-02240	Y	120	0.005	0.1	107	70	1100	232	3600	460	0.00722	0.469	40.2	182	4.639	69	2.28	-110	4.639	58
LSHRM 315 MN1	160	104-02700	Y	100	0.005	0.1	112	66	1100	289	3000	400	0.00495	0.358	40.2	188	3.601	65	1.989	-113	3.601	60
	160	104-02700	Y	120	0.005	0.1	112	66	1100	273	3600	400	0.00495	0.358	40.2	199	3.601	65	1.989	-113	3.601	60
	184	104-02700	Y	120	0.005	0.1	112	66	1100	283	3600	460	0.00495	0.358	40.2	192	3.601	65	1.989	-113	3.601	60
	200	114-04170	Y	100	0.005	0.1	123	69	1100	366	3000	400	0.00383	0.29	38.3	172	2.937	63	1.734	-114	2.937	61
LSHRM 315 MN1	200	114-04170	Y	120	0.005	0.1	123	69	1100	365	3600	400	0.00383	0.29	38.3	173	2.937	63	1.734	-114	2.937	61
	233	114-04170	Y	120	0.005	0.1	123	69	1100	359	3600	460	0.00383	0.29	38.3	175	2.937	63	1.734	-114	2.937	61
FLSHRM 280 SA	75	84-01340	Y	100	0.005	0.1	123	109	1800	138	3000	400	0.01637	0.794	38.3	185	7.412	65	4.063	-113	7.412	60
	75	84-01340	Y	120	0.005	0.1	123	109	1800	136	3600	400	0.01637	0.794	38.3	187	7.412	65	4.063	-113	7.412	60
	86.3	84-01340	Y	120	0.005	0.1	123	109	1800	135	3600	460	0.01637	0.794	38.3	189	7.412	65	4.063	-113	7.412	60
	90	84-01570	Y	100	0.005	0.1	112	88	1800	167	3000	400	0.01125	0.617	38.3	190	5.911	65	3.648	-113	5.911	60
FLSHRM 280 MA	90	84-01570	Y	120	0.005	0.1	112	88	1800	160	3600	400	0.01125	0.617	38.3	198	5.911	65	3.648	-113	5.911	60
	108	94-02000	Y	120	0.005																	



LEROY-SOMERTM



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